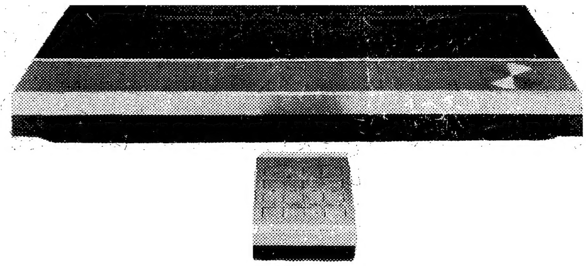
BEOMASTER 6000

TYPE 2702



TECHNICAL
PRODUCT INFORMATION

Bang & Olufsen

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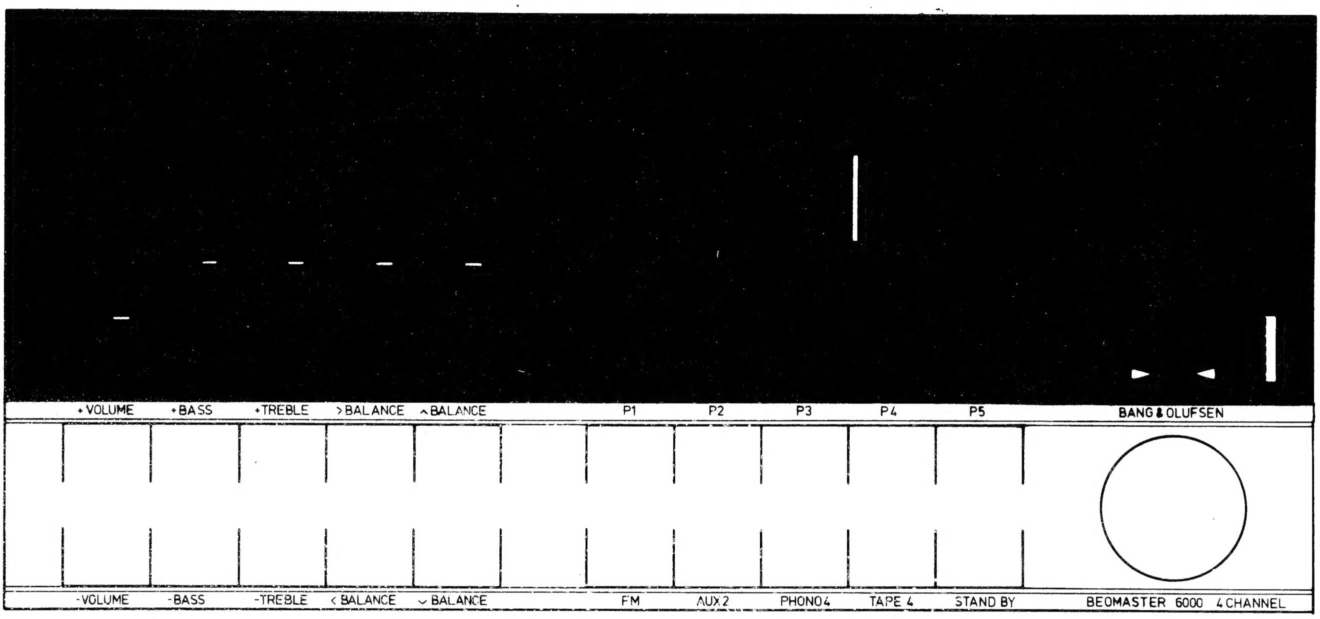
Bang & Olufsen



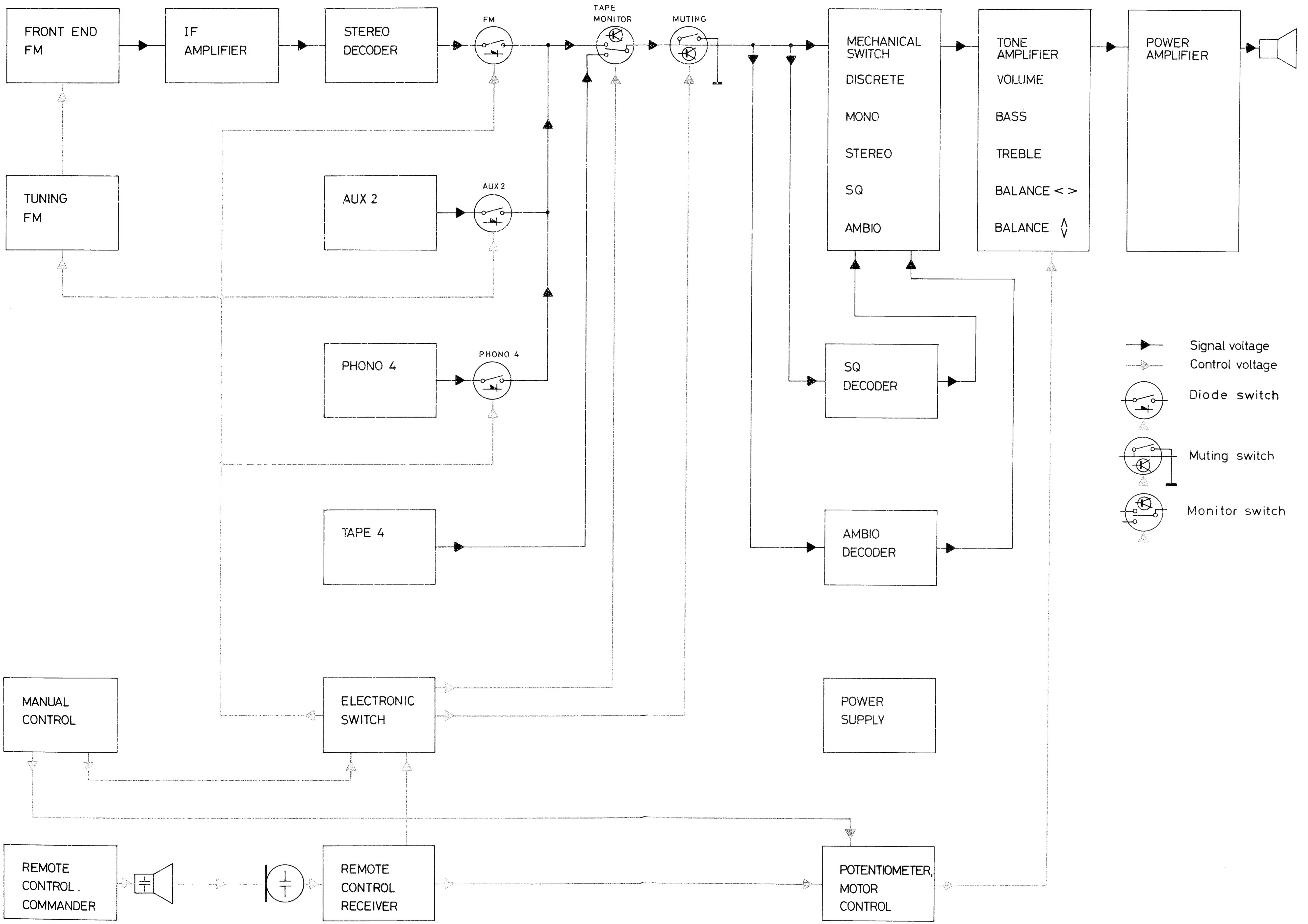
The Beomaster 6000 is basically a discrete 4-channel amplifier with built-in SQ and ambio decoders, and an FM tuner.

The set is designed with a view to simplifying 4-channel sound, and for operation to be simple and convenient.

It's high degree of operating convenience is obtained by means of a number of new circuits, such as ultrasonic remote control, motor-operated potentiometer control, and electronic switches.

This functional description covers all circuits of the Beomaster 6000, maximum attention being given however, to the new circuits.

Block Diagram 1



FRONT END FM
IF AMPLIFIER
STEREO DECODER
FM
TAPE MONITOR
MUTING
MECHANICAL SWITCH
DISCRETE
MONO
STEREO
SQ
AMBIO
TONE AMPLIFIER
VOLUME
BASS
TREBLE
BALANCE < >
BALANCE
POWER AMPLIFIER
TUNING FM
AUX 2
AUX 2
PHONO 4
PHONO 4
TAPE 4
SQ DECODER
AMBIO DECODER
Signal voltage
Control voltage
Diode switch
Muting switch
Monitor switch
MANUAL CONTROL
ELECTRONIC SWITCH
POWER SUPPLY
REMOTE CONTROL . COMMANDER
REMOTE CONTROL RECEIVER
POTENTIOMETER, MOTOR CONTROL

Block Diagram 1

The Beomaster 6000 has the following inputs and functions:

FM plus 5 fixed-tunable stations.
AUX 2, HI or LO, input/output.
Phono 4.
Tape 4, input/output.
Electronic switch for programme selection. Electronic push-button operation of volume, balance, and tone controls.

Mechanical switch for selection of: HI, LO, loudness, mono, stereo, ambio, SQ, AFC/silent tuning, two speaker switches.
Remote control using ultrasonic transmitter.
Muting during programme switching, and silent tuning on FM.

Block Diagram 2

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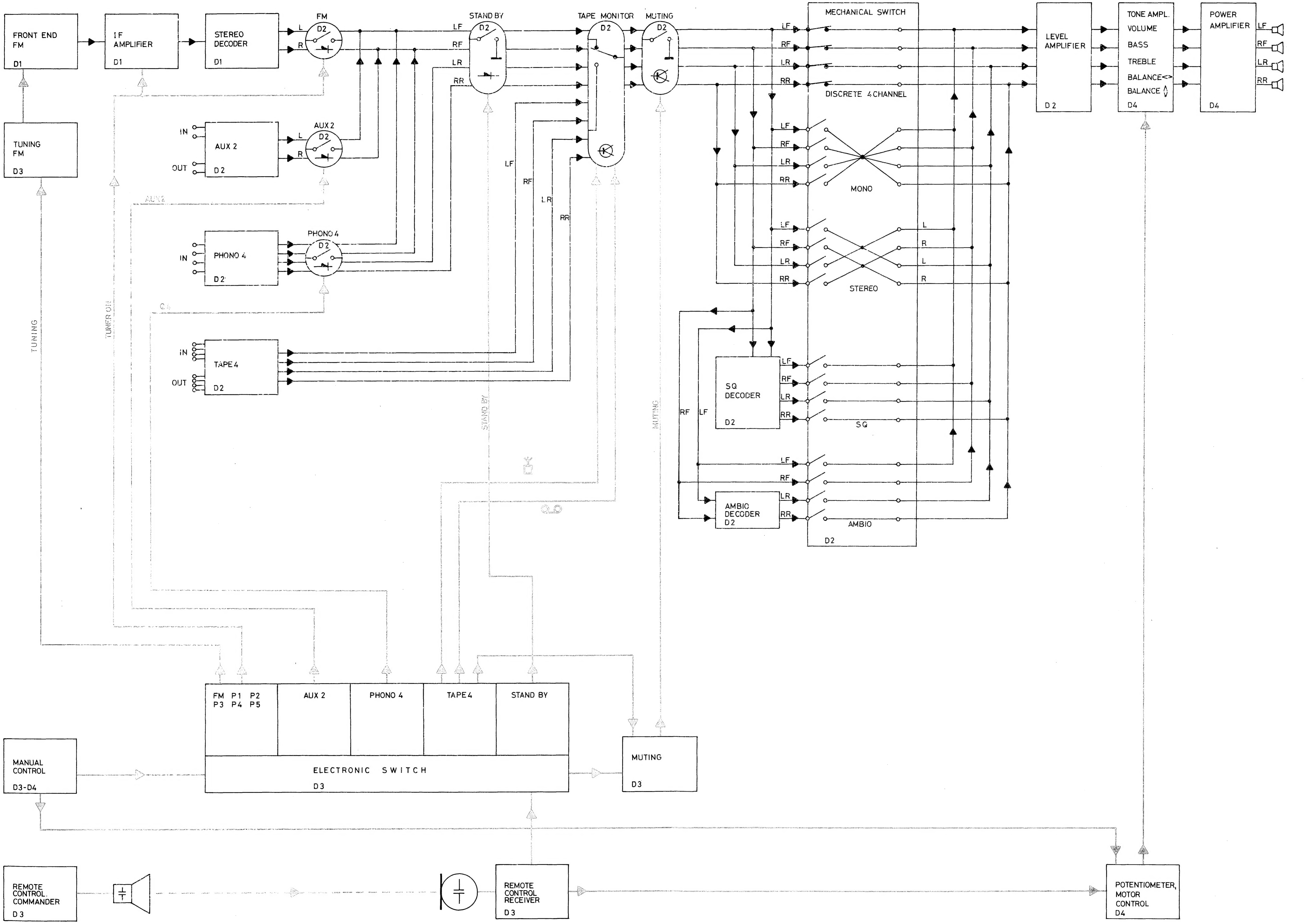


Block Diagram 2

Phono 4 and Tape 4 signals will be played as four separate channels if no buttons in the mechanical switch section are depressed.

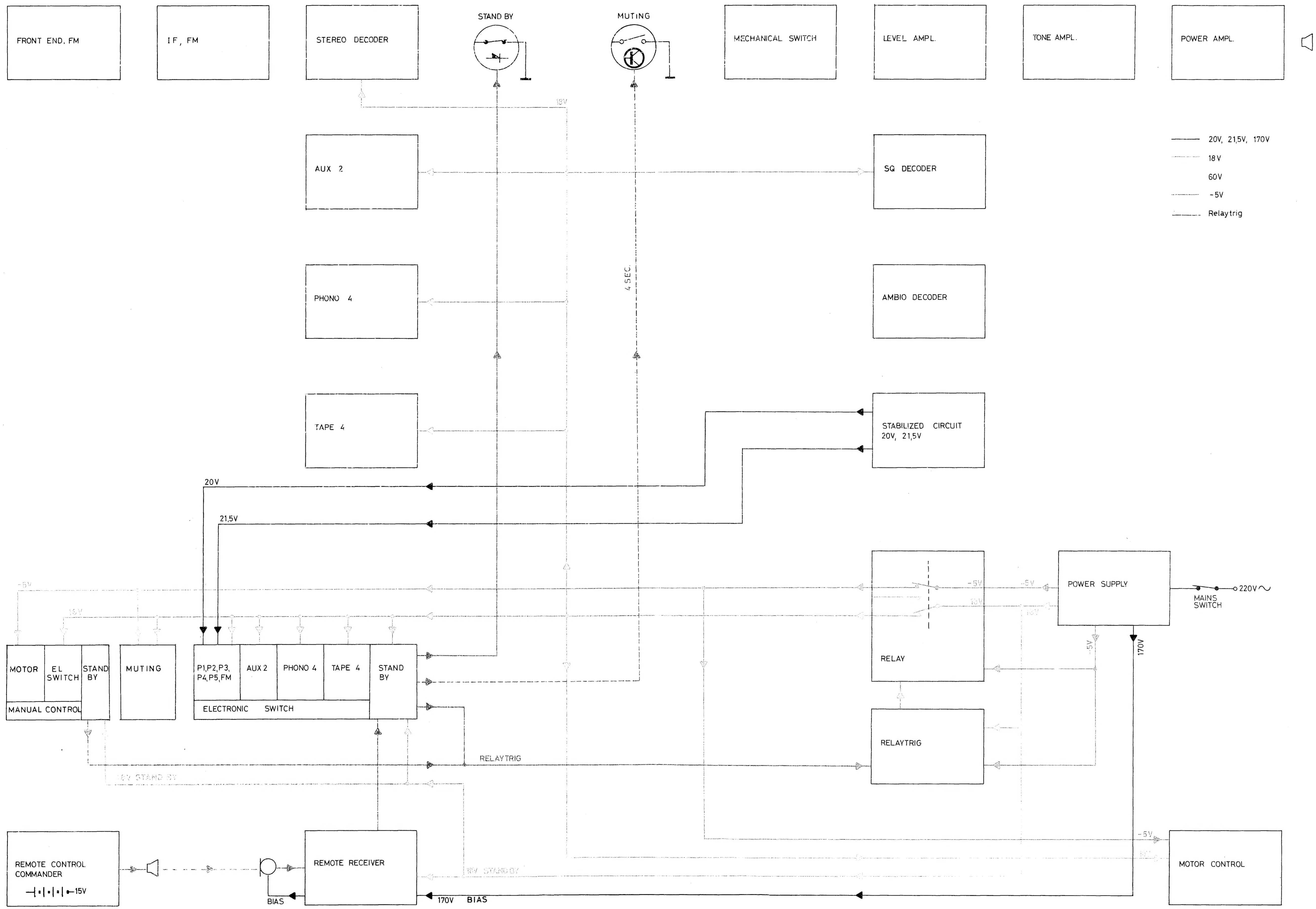
FM and AUX 2 signals will be played as stereo in the front channels, LF and RF, if no buttons in the mechanical switch section are depressed. With the stereo button depressed, stereo will be played in both front and rear channels. The other systems appear from the mechanical switch block diagram.

The electronic switch delivers control voltages to open and close the switches during programme switching.

Unlike the other functions, which employ diode switching, the tape 4 function employs transistor circuits for switching. This function differs from the other ones because tape 4 has a monitor function and does not have to release the other function.
From the commander it is possible to control P1, P2, P3, P4, P5, Phono 4, Tape 4, Stand By, Volume, Balance < > and balance $\overset{\wedge}{\vee}$.

FUNCTIONAL BLOCK DIAGRAM
STAND BY „ON"
Voltage diagram

Bang & Olufsen



STAND BY ON

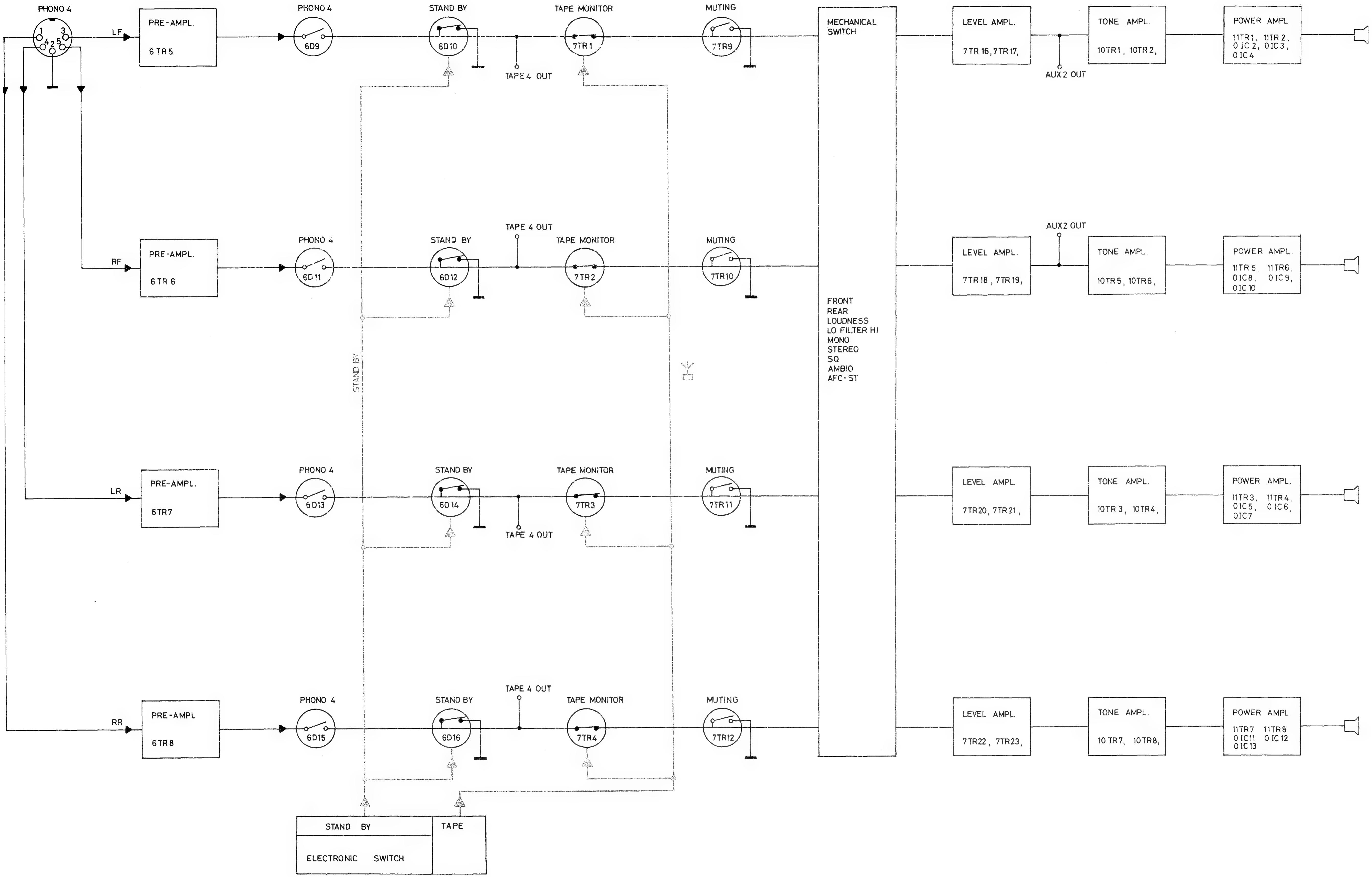
Stand By „ON" – Voltage Diagram

When the mains switch (on the rear of the receiver) is closed, a relay triggering circuit causes the relay to operate. This means that the receiver will always go into the Stand By „ON" condition when the mains switch is closed. In the Stand By „ON" condition, the receiver's potentiometer dial is illuminated. When the Stand By „ON" function is activated, either from manual control or from remote control, a control voltage (relay trig) is fed to the relay. The relay operates, and all circuits, except the FM-front end and IF circuits, receive supply voltages.

Switching from Stand By „OFF" to Stand By „ON" triggers off an approx. 4 sec. time constant in the Stand By circuit, thereby activating the muting transistors.

FUNCTIONAL BLOCK DIAGRAM STAND BY „ON"

Bang & Olufsen



STAND BY "ON"

Stand By „ON"

A positive voltage is fed to diodes, 6D10 - 12 - 14 - 16, which will by-pass signals, if any, to chassis potential. The voltage for these diodes will disappear when a programme is selected, except for Tape 4, which cannot release the Stand By „ON" function.

The tape monitor circuit, 7TR1 - 2 - 3 - 4, will receive a positive voltage from the tape circuit of the electronic switch, and the transistors will therefore be ON.

FUNCTIONAL BLOCK DIAGRAM
PHONO 4

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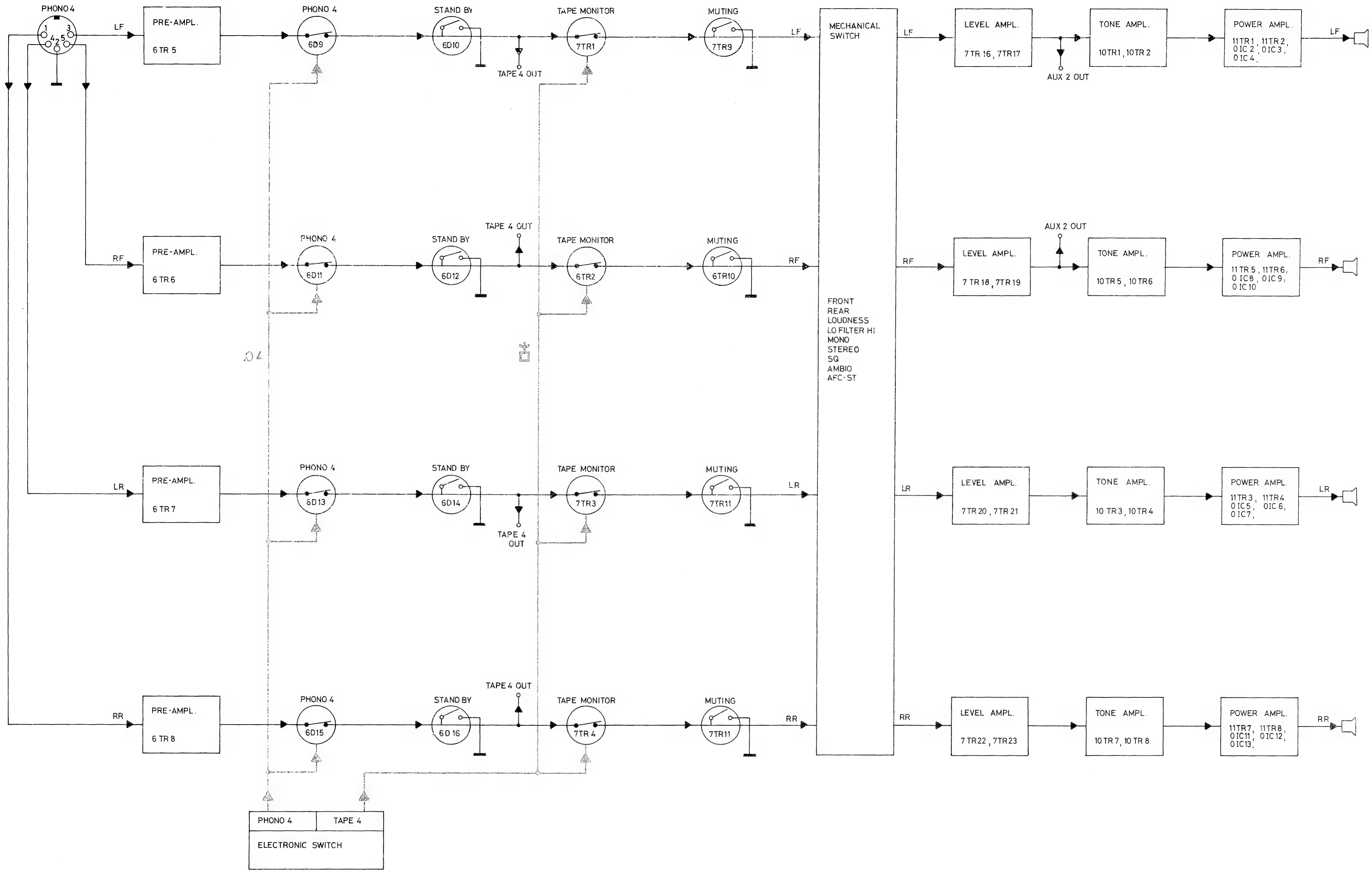


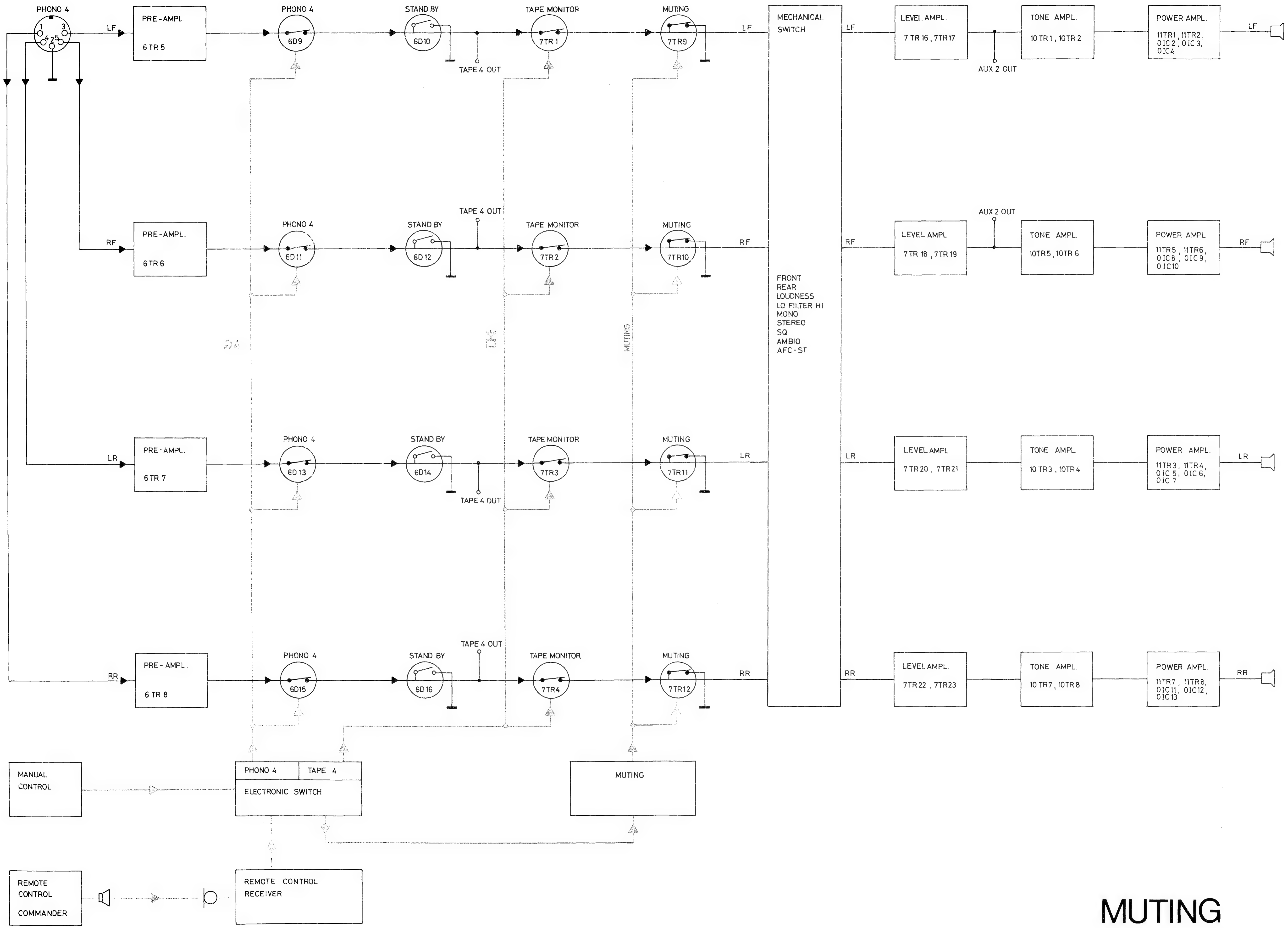
PHONO 4

Phono 4

Operating the Phono 4 switch causes a positive voltage to be fed to the anodes of diodes, 6D9 - 11 - 13 - 15, which will conduct, and the Phono 4 input signal can pass.

The tape monitor circuit likewise receives a positive voltage, and transistors, 7TR1 - 2 - 3 - 4, admit the Phono 4 signal.

FUNCTIONAL BLOCK DIAGRAM
MUTING


PHONO 4
PRE-AMPL.
6 TR 5
6 TR 6
6 TR 7
6 TR 8
PHONO 4
6D9
6D11
6D13
6D15
STAND BY
6D10
6D12
6D14
6D16
TAPE 4 OUT
TAPE MONITOR
7TR1
7TR2
7TR3
7TR4
MUTING
7TR9
7TR10
7TR11
7TR12
LF
RF
LR
RR
MECHANICAL SWITCH
FRONT
REAR
LOUDNESS
LO FILTER HI
MONO
STEREO
SQ
AMBIO
AFC-ST
LEVEL AMPL.
7 TR 16, 7 TR 17
7 TR 18, 7 TR 19
7 TR 20, 7 TR 21
7 TR 22, 7 TR 23
AUX 2 OUT
TONE AMPL.
10 TR 1, 10 TR 2
10 TR 5, 10 TR 6
10 TR 3, 10 TR 4
10 TR 7, 10 TR 8
POWER AMPL.
11TR1, 11TR2, 0IC2, 0IC3, 0IC4
11TR5, 11TR6, 0IC8, 0IC9, 0IC10
11TR3, 11TR4, 0IC5, 0IC6, 0IC7
11TR7, 11TR8, 0IC11, 0IC12, 0IC13
MANUAL CONTROL
PHONO 4
TAPE 4
ELECTRONIC SWITCH
MUTING
REMOTE CONTROL COMMANDER
REMOTE CONTROL RECEIVER

MUTING

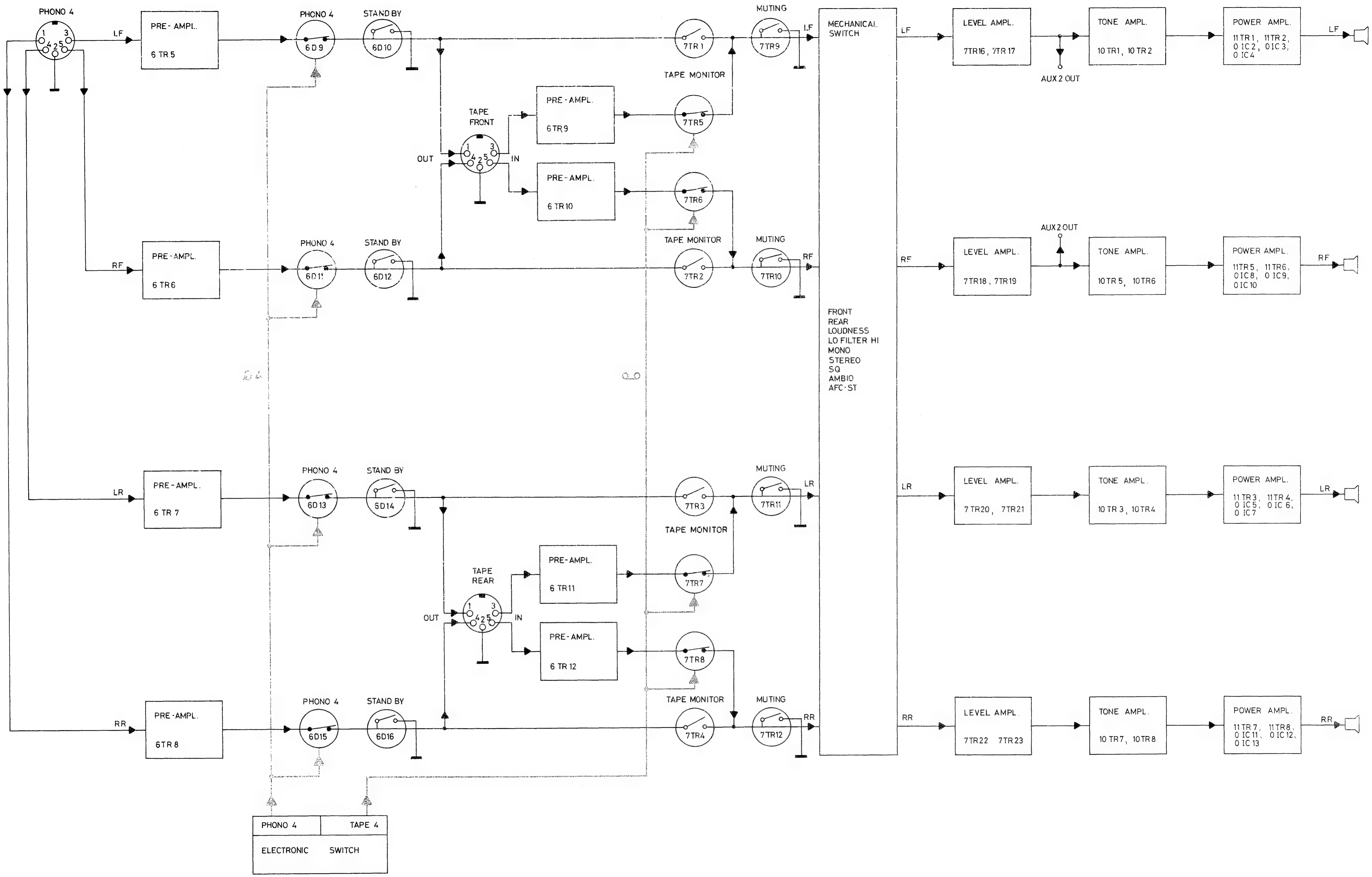
Muting

When a programme is selected, say Phono 4 (from Stand By „ON“), a positive voltage from the muting circuit is fed to transistors, 7TR9 - 10 - 11 - 12, for approx. 1/4 sec. The transistors short-circuit the signal while the electronic switch is operative. When muting transistors, 7TR9 - 10 - 11 - 12, subsequently go OFF, the signal is routed via circuits 6D9 - 11 - 13 - 15 and 7TR1 - 2 - 3 - 4 to the amplifiers.

When Phono 4 is again pressed, the muting circuit will *not* be triggered.

FUNCTIONAL BLOCK DIAGRAM
TAPE MONITOR

Bang & Olufsen



TAPE MONITOR

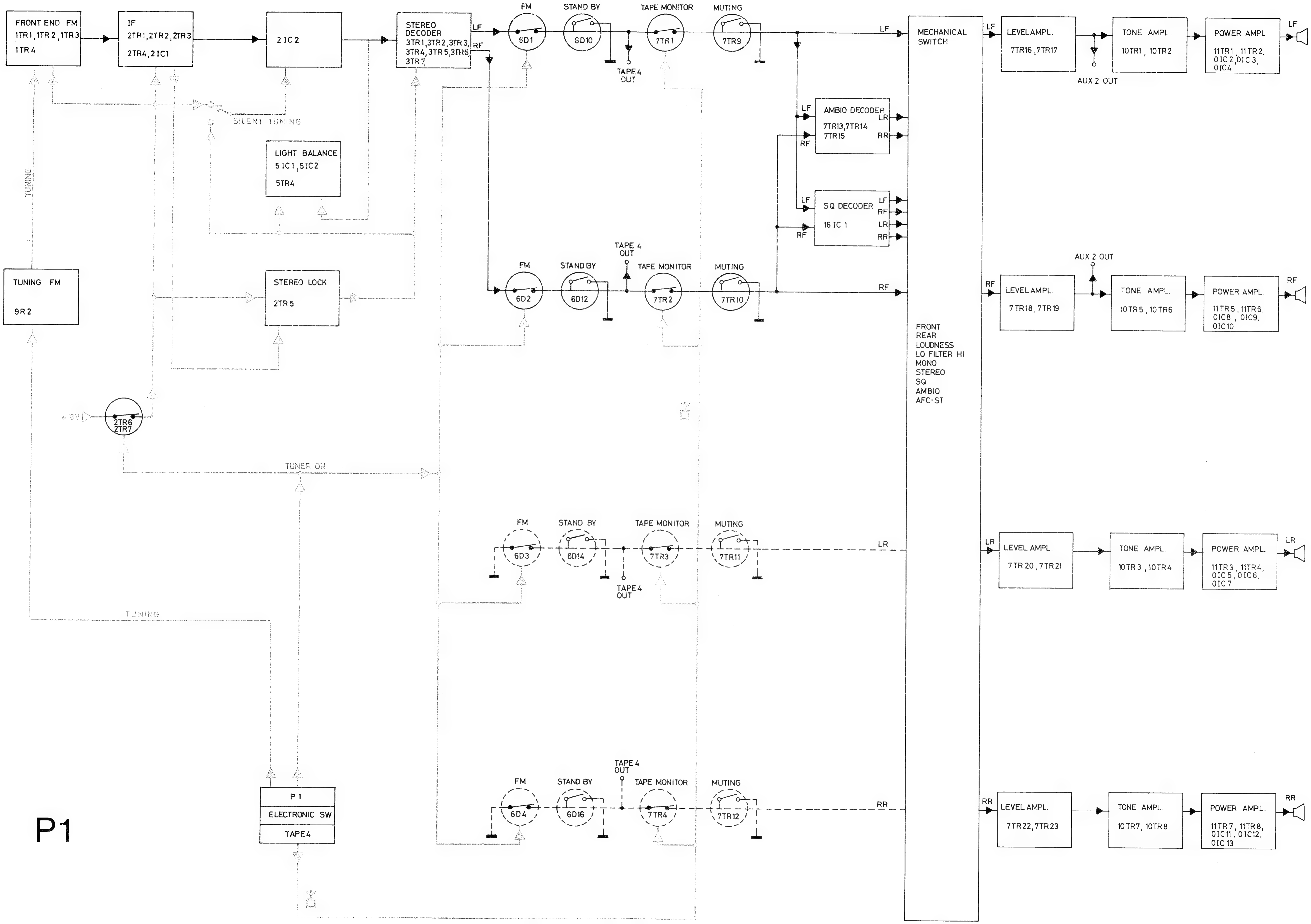
Tape Monitor

Tape monitoring of, say Phono 4 requires that the Tape button be depressed. This causes one of the tape monitor circuits, 7TR1 - 2 - 3 - 4, to be disabled whilst the other tape monitor circuit, 7TR5 - 6 - 7 - 8, is activated by a positive voltage from the electronic switch.

The Tape button cannot release Phono 4 switches, 6D9 - 11 - 13 - 15, but pressing the Phono 4 button again removes the voltage for activating the circuit 7TR5 - 6 - 7 - 8 whereas the circuit 7TR1 - 2 - 3 - 4 again receives positive voltage and feeds the Phono 4 signal to the mechanical switch.

FUNCTIONAL BLOCK DIAGRAM P1

Bang & Olufsen

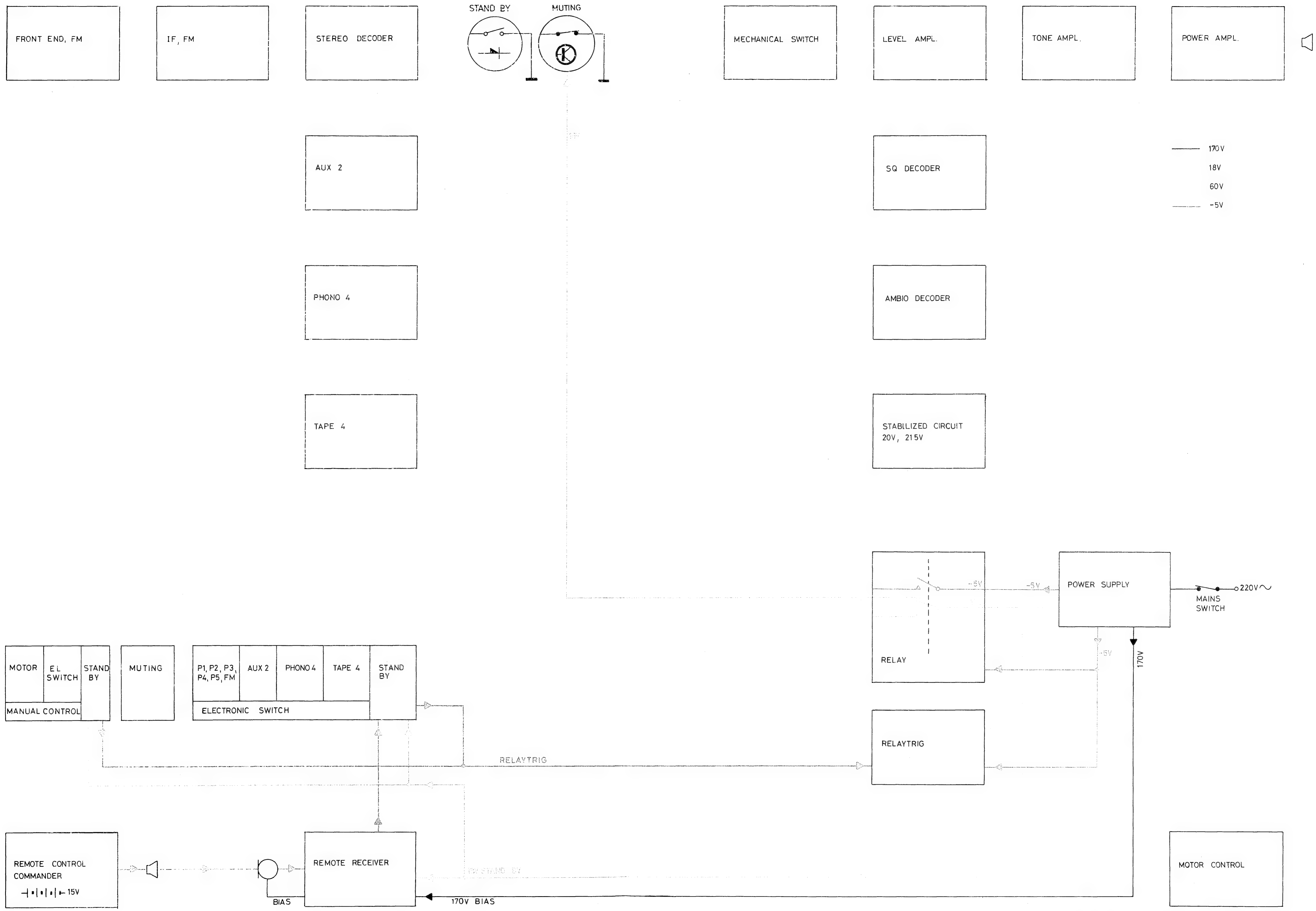


P1

When the P1 switch is operated, the electronic switch provides a positive voltage which is used for the P1 tuning potentiometer and for applying supply voltage to the front end, IF section, and 2IC2. The SILENT TUNING switch selects whether 2IC2 is to receive its supply voltage directly from 18 volts (2TR6, 2TR7) or from the transistors 2TR5. With the supply voltage obtained from 2TR5, the receiver will have silent tuning.
This voltage serves the additional purpose of biasing diodes, 6D1 - 2 - 3 - 4, in their forward direction so that the FM signal is fed to the amplifiers. Diodes 6D3 and 6D4 are biased even in the absence of signals in the rear channels, LR and RR, during FM programmes. This has been done in the interest of the coming quadraplex system. The tape monitor circuit, 7TR1 - 2 - 3 - 4, receives a positive voltage from the electronic-switch tape circuit, which makes the transistors feed the signal on to the mechanical switch. 7TR3 and 7TR4 are ON even in the absence of signals in LR and RR.
With AUX 2 operated there will also be no signals in the rear channels, LR and RR, but 7TR3 and 7TR4 will be ON in this case too.
The mechanical switch has a choice of whether the FM stereo signal (or AUX 2 signal) is to be played as mono, stereo, ambio, or SQ. In the SQ or ambio position, the signal is fed through the SQ decoder, 16IC1, or the ambio decoder, 7TR13 - 14 - 15, and only thereafter reaches the four channels.

FUNCTIONAL BLOCK DIAGRAM
STAND BY „OFF”
Voltage diagram

Bang & Olufsen



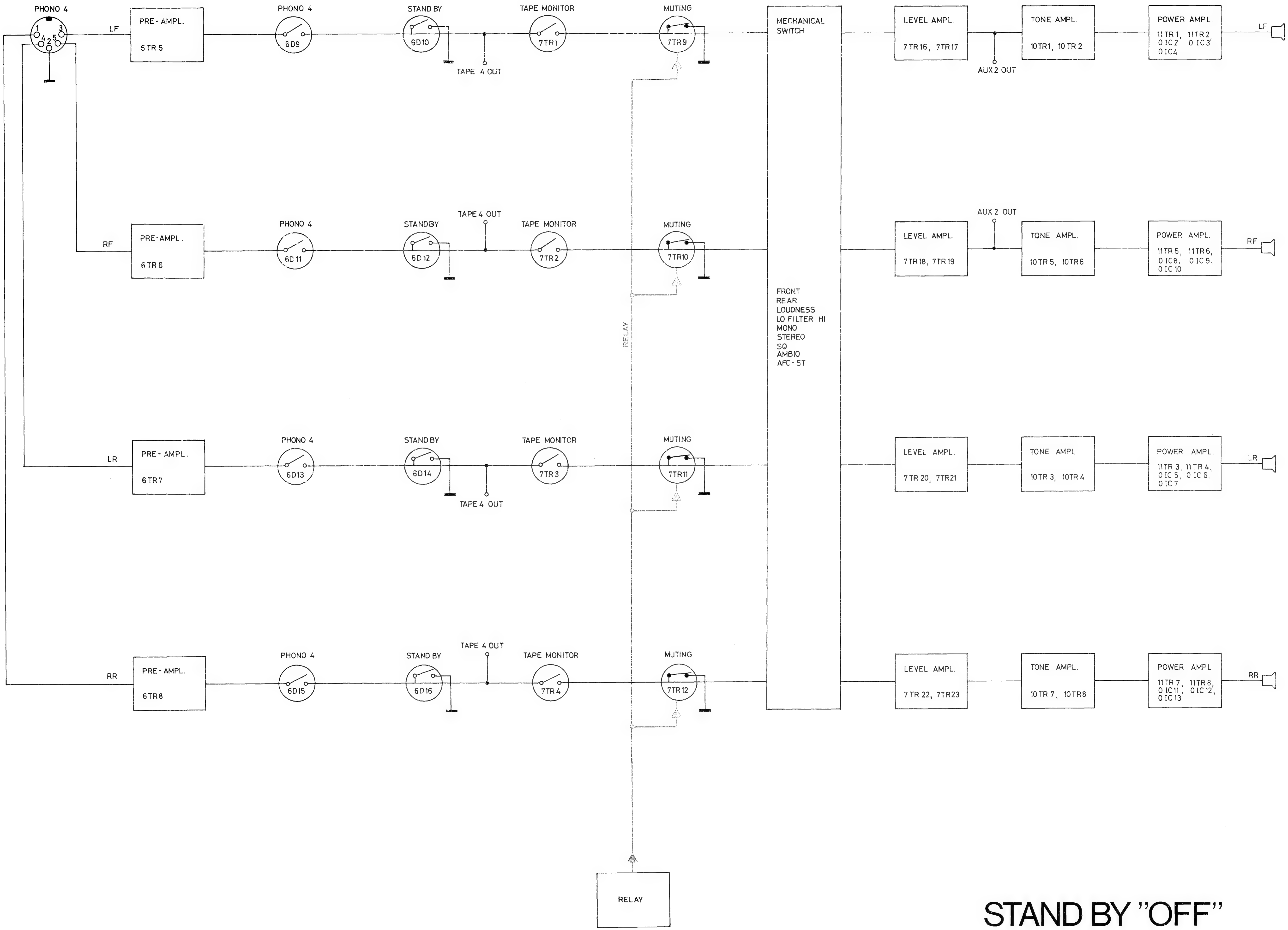
STAND BY OFF

Stand By „OFF" – Voltage Diagram

When Stand By „OFF" is operated, the control voltage (relay trig) de-energises the relay. This causes all supply voltages to be removed, except 18 V Stand By. The muting transistors 7TR9 - 10 - 11 - 12, receive a positive voltage from the relay switch.

FUNCTIONAL BLOCK DIAGRAM STAND BY „OFF"

Bang & Olufsen



STAND BY "OFF"

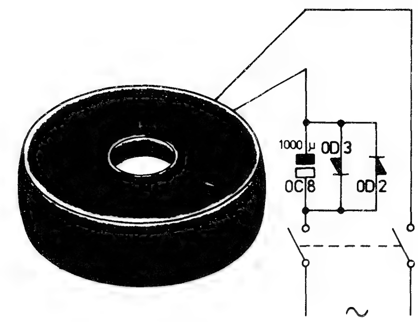
Stand By „OFF"

A positive voltage from the power supply section is fed via relay contacts, 11 and 12, to the bases of muting transistors, 7TR9 - 10 - 11 - 12, thus removing clicking, if any, by relay contacts.

POWER SUPPLY

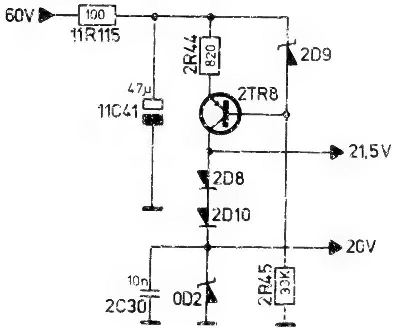
The receiver is powered from six different voltages: 60 V, 18 V, -5 V, 20 V, 21.5 V, and 170 V. The power transformer is a ring-core unit which has large power handling capability and a minimum AC field for it's physical dimensions.

Because it has no air gap the transformer is, however, sensitive to the presence of any DC on the mains voltage (set using half-wave rectification connected to the same mains wire as the Beomaster 6000).
This DC voltage if approx. 0.5 V is capable of saturating the transformer's core with 1/3 of the total magnetisation in the no-signal condition, Stand By OFF, which would cause the transformer to hum.



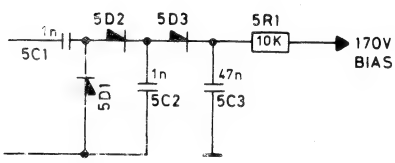
For the purpose of removing DC, a circuit (patent applied for by Bang & Olufsen) has been inserted in series with the mains voltage. The circuit is composed of 0C8, 0D2, and 0D3. The capacitor will block the passage of DC while the diodes are to relieve the capacitor by shorting it while the receiver is in operation.

The power transformer has two secondaries, 42 V and 27 V. From the 42 V secondary, 60 V is obtained which powers the output amplifier and the ambio decoder. The 60 V supply is employed without stabili-

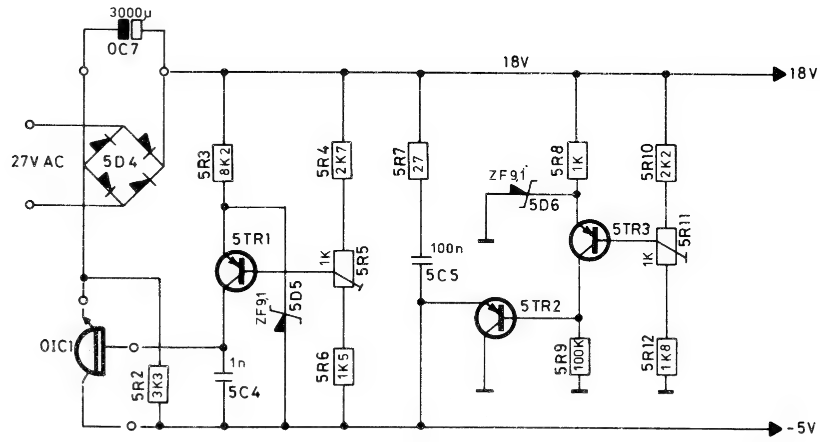


sation, only by-passed by 0C5. The 60 V supply also feeds power through a filter consisting of 11R115 and 11C41 to a stabiliser circuit composed of transistor 2TR8, zener diodes 2D9 and 0D2, and diodes 2D8 and 2D10.
The diodes, 2D8 and 2D10, are to provide the exact voltage difference of 1.5 V between 20 V and 21.5 V employed in the EL switch.

Ahead of the rectifier, 0D1, 42 V is taken off for the voltage tripler consisting of diodes 5D1, 5D2, and

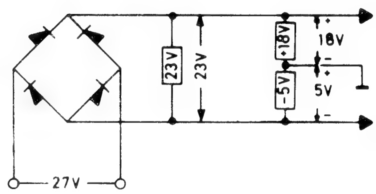


5D3. The approx. 170 V generated in the voltage tripler serves as bias voltage for the microphone, 14CM1, in the ultrasonic receiver. The 170 V potential can only be measured with a meter having an input resistance of not less than 50 megohms.



The 27 V secondary is employed for the stabilised 18 V and -5 V supply. The 18 V supply is used for relay power, remotely controlled receiver, EL switch, input amplifiers, FM section, SQ decoder, lamps for FM potentiometer dials and motor control. The -5 V supply is used for relay power, muting, EL switch, lamps for FM and potentiometer dials and motor control.

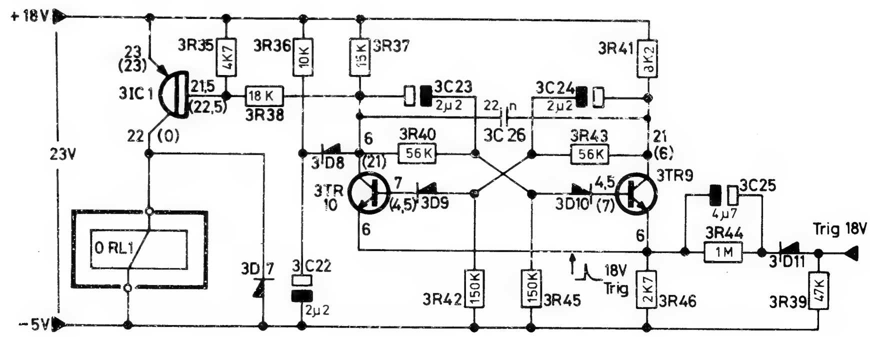
The stabilised power supply, consisting of series transistor 0IC1 and the stabiliser circuit comprising 5TR1 and zener diode 5D5, supplies 23 V for the 18 V and -5 V stabiliser circuit. This circuit consists of 5TR2 and 5TR3 as well as zener diode 5D6. The 18 V potential is produced by connecting transistor 5TR2 so that the voltage across the transistor is 5 V. The positive side of the



5 V potential (the collector of 5TR2) is connected to chassis potential. 18 V will then be present between chassis potential and the positive side of 23 V. -5 V is present between chassis potential and the negative side of 23 V.

STAND BY RELAY TRIGGER CIRCUIT

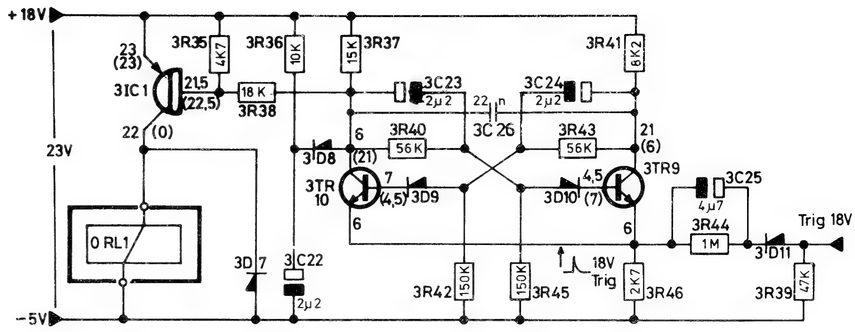
Keying of the supply voltages for the receiver is done with a relay which is controlled from a bistable multivibrator.



The voltages specified were measured with respect to -5 V.

Bracketed voltages = Stand By OFF; without brackets = Stand By ON.

When the mains switch is closed, the circuit receives 23 V in the form of +18 V and -5 V. To make the relay operate, 3IC1 must go ON. 3IC1 is controlled by a voltage from multivibrator 3TR9/3TR10.



At the moment of starting, when the mains switch is closed, capacitor 3C22 charges through diode 3D8. The voltage at the collector of 3TR10 will then drop. The voltage at the base of 3TR9 will drop to 4.5 V because the base of 3TR9 is connected to the collector of 3TR10. Transistor 3TR9 will go OFF, and the voltage at the collector will increase to 21 V. 3TR10 now receives 7 V at its base, being kept ON.

When 3TR10 is ON, 6 V is present at its collector. The voltage at the base of 3IC1 will then drop from 22.5 V to 21.5 V, and 3IC1 will receive sufficient bias (1.5 V) to go ON. The relay connected to the collector of 3IC3 will receive 23 V, causing it to operate (Stand By ON).

If „STAND BY“ is operated, a trigger pulse from the EL switch will apply a positive pulse of 18 V to the emitters of 3TR9 and 3TR10. Both transistors will go OFF briefly until the trigger pulse disappears.

While 3TR10 was ON, capacitor 3C24 had a higher voltage across it than 3C23, hence the base of 3TR10 will have a lower voltage than that at the base of 3TR9 when the trigger pulse disappears from the emitters, causing 3TR10 to go OFF. 21 V will then be present at the collector of 3TR10, with the result that 3TR9 receives 7 V at its base and goes ON. This keeps 3TR10 OFF because the voltage at its base drops to 4.5 V and the voltage at its emitter is 6 V. When the voltage at the collector of 3TR10 rises to 21 V, the base of 3IC1 will carry 22.5 V; the IC will go OFF and the relay release (Stand By OFF).

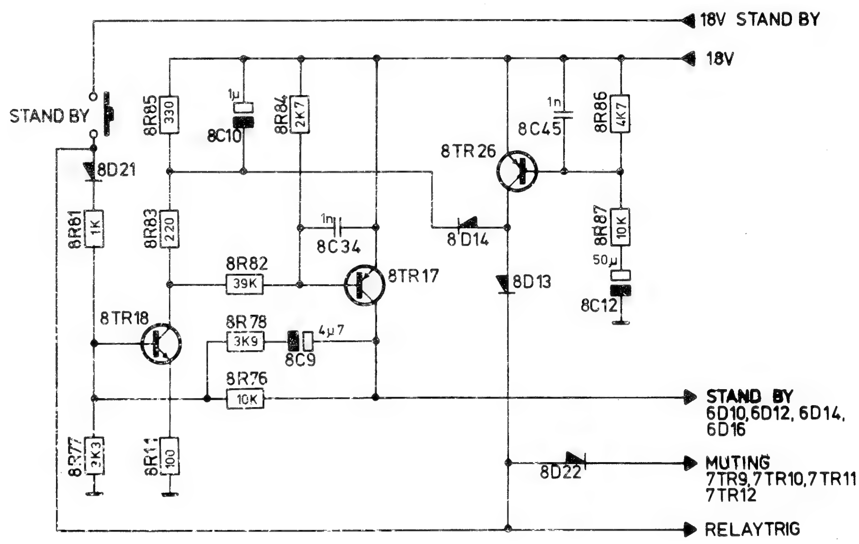
Capacitor 3C36 in the case of brief pulses (noise) remembers which transistor was ON.

STAND BY CIRCUIT

Stand By ON When Mains Switch Is Operated

When 220 V is applied to the receiver or the mains switch is operated, the receiver will go into the Stand By ON condition. This means that power is applied to all circuits (except the tuner and IF section) and the potentiometer dial is illuminated.

When the mains switch is operated, the relay trigger circuit will receive supply voltage, 18 V Stand By and -5 V. The relay will operate, delivering supply voltage, +18 V, to the EL switch.



At the moment of starting, capacitor 8C12 will have no charge. The base of 8TR26 therefore receives a voltage lower than the 18 V applied to the emitter of 8TR26. The transistor will go ON, and will remain ON until 8C12 has built up a charge, which takes approx. 4 seconds. When ON, 8TR26 will have 18 V at its collector, which is fed to muting transistors 7TR9, 7TR10, 7TR11 and 7TR12 via diodes 8D13 and 8D22. The muting transistors will go ON, shorting the signal path to chassis potential until 8C12 has received a charge. When the capacitor is charged, 18 V will be present at the base of 8TR26, and the transistor will go OFF. The collector voltage of 8TR26 will drop to -5 V because diodes 8D13 and 8D22 provide a connection to the -5 V supply.

When 8TR26 goes ON, the 18 V potential at the collector is transmitted to the base of 8TR18, causing it to go ON. Since the collector of 8TR18 is connected to the base of 8TR17 through a resistor, 8TR17 will go ON too. The circuit will remain ON because 8TR17 and 8TR18 are DC-coupled through 8R76 and 8R82.

The collector of 8TR17 is connected to the anodes of diodes 6D10, 6D12, 6D14, and 6D16, and when 18 V is present at the collector, the diodes go ON, short-circuiting the signal path to chassis potential.

At the moment of starting, heavy current will flow through 8TR18 because 8R85 is shunted by 8D14 and 8TR26. By giving 8TR18 a high value of current at the start it is ensured that only Stand By can go ON since the voltage across 8R11 will prevent all other programmes from going ON.

The collector of 8TR26 is connected to the base of 8TR18 in order to bias the latter until the circuit (18TR17 and 18TR18) is ON.

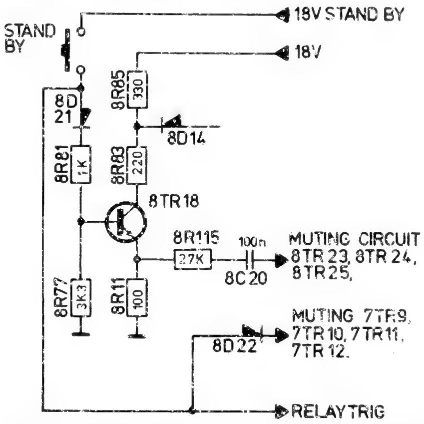
The connection between 8TR26 and 8TR18 includes two diodes. One of them, 8D21, blocks the passage of the -5 V potential (to the base of 8TR18) that appears when 8TR26 goes OFF. The other

diode, 8D13, ensures that 18 V does not reach the collector of 8TR26.

Between the collector of 8TR17 and the base of 8TR18 is a speed-up network, 8R78/8C9, to ensure that changes on one transistor are transmitted quickly to the other, and vice versa.

Stand By ON When Contact Pair Is Operated

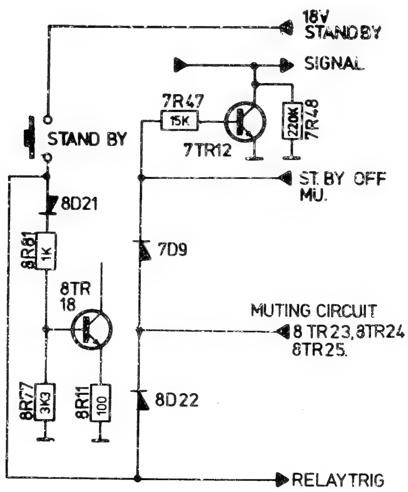
When Stand By ON is activated from Stand By OFF, 18 V is fed from the 18 V stand By line through the manual switch to the relay trigger circuit and simultaneously through 8D22 to muting transistors 7TR9, 7TR10, 7TR11 and 7TR12 which short-circuit the signal path to chassis potential during the relay switching function. The relay trigger circuit makes the relay operate, as a result of which the EL switch and the other circuits receive supply voltages. The Stand By circuit will now function as described above and remain in the Stand By ON condition.



The instant the Stand By ON function is activated and heavy current flows through 8TR18, a high voltage will also appear across emitter resistor 8R11. This voltage increase is transmitted to the muting circuit (8TR23, 8TR24, 8TR25) as a pulse, activating it. The muting circuit feeds 18 V to transistors 7TR9, 7TR10, 7TR11 and 7TR12, activating them for approx. 1/4 second. This function is employed for programme switching. However, this interval is not long enough when the receiver is to go into Stand By ON. There will not be enough time for the amplifiers to reach operating conditions before the muting transistors go OFF again. To ensure that the muting transistors will remain ON for some length of time, 8D22 has been added.

Stand By OFF

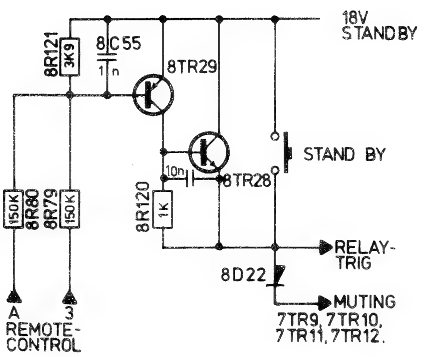
When Stand By OFF is activated, 18 V is fed to the relay trigger circuit and to 8D22.



The relay cuts off, and the supply voltages disappear. 8D22 must conduct 18 V to muting transistors 7TR9, 7TR10, 7TR11 and 7TR12 instead of the muting circuit (8TR23, 8TR24, 8TR25) which will be disabled in the absence of supply voltages. The muting transistors are kept ON by 8D22 until the relay contacts (11, 12, 13) have switched, when 18 V will appear on the ST. BY OFF MU. wire. In the Stand By OFF condition, therefore, muting transistors 7TR9, 7TR10, 7TR11 and 7TR12 are kept ON, first by 8D22 and thereafter by 18 V from the power supply section.

Diode 7D9 has no influence on the muting function, its object being to block the passage of white noise from the -5 V supply line (zener diode). White noise from the -5 V line will cause a poor signal-to-noise ratio.

Remote Control of Stand By

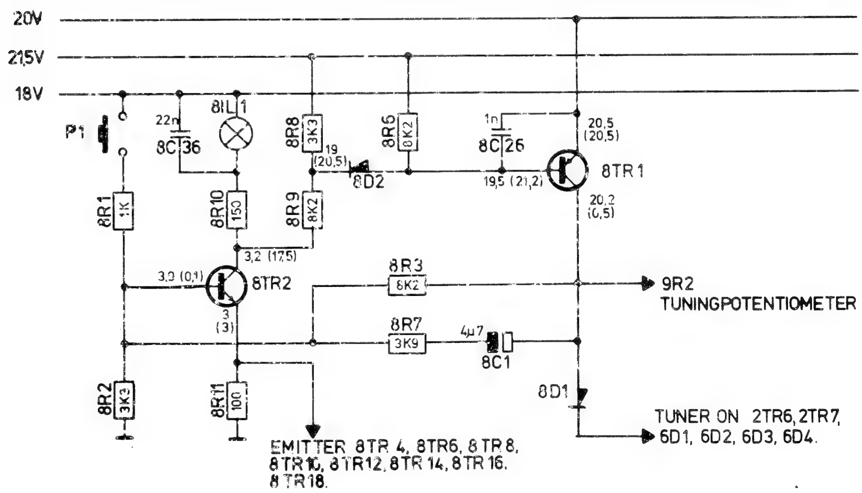


When Stand By ON on the remote control unit is operated, a circuit is triggered (8TR28/8TR29) which momentarily shunts the Stand By switch.

The circuit is triggered by short-circuiting the two transistors, 8R79 and 8R80, to chassis potential. This makes the base voltage of 8TR29 go towards zero, and the transistor will go ON. When 8TR29 is ON, current will flow through 8R120, and when the current exceeds 0.7 mA, 8TR28 will go ON and 18 V be fed to the relay trigger circuit and the muting transistors. The relay trigger circuit makes the relay operate; and, during the relay switching function, muting transistors 7TR9 to 7TR12 inclusive receive 18 V through 8D22, short-circuiting the signal path to chassis potential. When the relay is operated, supply voltage is present at the EL switch, and the Stand By circuit will now function as described under Stand By ON.

During remote control of Stand By OFF, the circuit (8TR28/8TR29) functions in the same manner as for Stand By ON, shunting the switch. The relay trigger circuit and muting transistors 7TR9 to 7TR12 inclusive are fed with 18 V. The relay switches over, and the supply voltages disappear. The operation of these circuits is the same as described under Stand By OFF.

P 1



Nonbracketed voltages: Circuit ON.

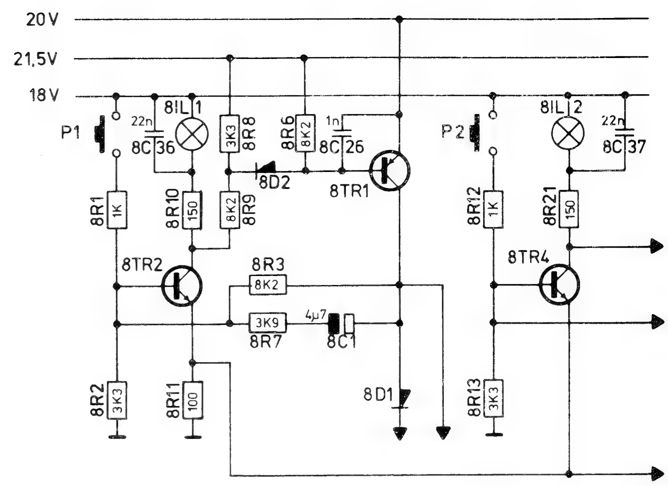
Bracketed voltages: Circuit OFF.

The diagram section shown is the P1 function of the EL switch which during switching to P1 delivers 20 V to the tuning potentiometer 9R2 and, via diode 8D1, a positive voltage to open up diodes 6D1, 6D2, 6D3 and 6D4 so that the FM signal can be fed to the amplifiers.

The same voltage is also used to make transistors 2TR6 and 2TR7 go ON, enabling the 18 V supply voltage to be fed to the tuner, IF section, and 2IC2.

When the P1 switch is operated, the base of 8TR2 receives a positive voltage, and the transistor goes ON. This results in a voltage drop at the midpoint of the voltage divider, 8R8/8R9, and hence at the base of 8TR1. Transistor 8TR1 goes ON, and its collector voltage opens up diodes 6D1 to 6D4 inclusive, making transistors 2TR6 and 2TR7 go ON, and delivers voltage to tuning potentiometer 9R2.

Switching



In order that the P1, P2, P3, P4, P5, FM, AUX 2. Phono 4, and Stand By functions can release each other mutually, they have a common emitter resistor, 8R11. Assuming that P2 is ON, approx. 3 V will be present at the common emitters. If, say, that P1 switch is operated, 8TR2 will go ON and the voltage across emitter resistor 8R11 will rise to approx. 7 V because the lamp 8IL1 has low impedance, approx. 40 ohms, the moment the switch is operated.

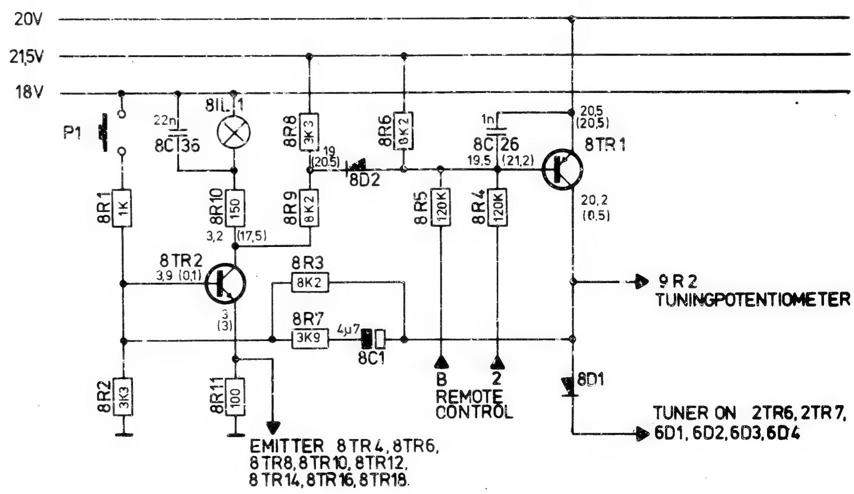
This voltage increase at the emitter will cause the bottom transistor, 8TR4, of the P2 function to go OFF, in turn making the entire P2 function go OFF. The voltage across emitter resistor 8R11 will again drop to approx. 3 V; the resistance of 8IL1 will have increased to 400 ohms; and P1 will be ON.

Capacitor 8C36 across the lamp allows the circuit to function in the event of a defective lamp. At the moment of starting, the capacitor, like the lamp, will deliver a current peak which makes 8TR2 go ON.

Components 8C1 and 8R7 are a speed-up network to ensure that changes at one transistor are quickly transmitted to the other and vice versa. This means that the entire circuit (P1) will switch quickly between ON and OFF.

Capacitor 8C26 prevents clicks from contact bounces causing the receiver to switch programmes.

Remote Control of P1



Nonbracketed voltages: Circuit ON.

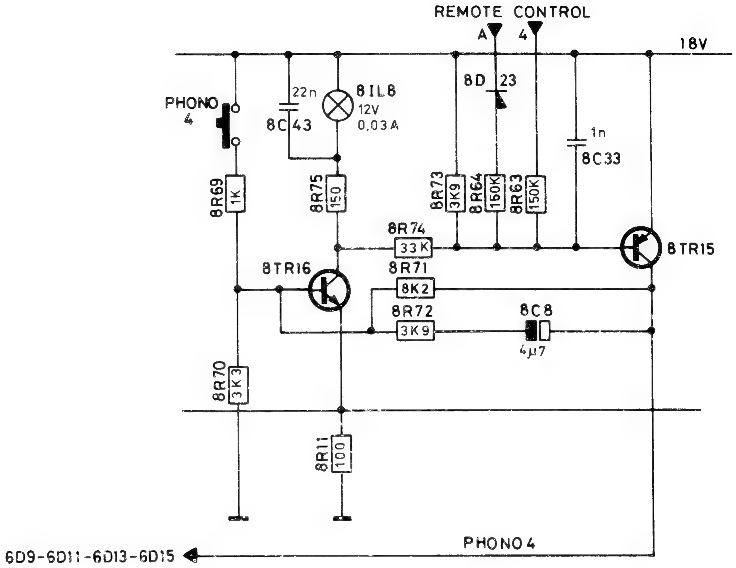
Bracketed voltages: Circuit OFF.

In remote control operation it is transistor 8TR1 that is triggered. When P1 on the remote control unit is operated, a trigger pulse is generated which connects the two 120 k ohm resistors, 8R4 and 8R5, to chassis potential. This causes the voltage at the base of 8TR1 to drop to 19.5 V, and

the transistor goes ON. The 20 V potential at the collector of 8TR1 will, via resistor 8R3, make 8TR2 go ON, and the two transistors will keep the P1 function ON.

8D2, inserted between 8R6 and 8R8, ensures that 8TR1 will receive the full trigger pulse and go ON.

PHONO 4



The Phono 4 circuit is identical with the FM programme circuits and is connected to the common emitter resistor 8R11. When the switch is operated, 8TR16 goes ON, and voltage drops occur at the collector of 8TR16 and base of 8TR15. 8TR15 goes ON, receiving 18 V at its collector. This 18 V potential is used to provide passage for the Phono 4 signal by means of diodes 6D9, 6D11, 6D13 and 6D15, which are forward biased.

Remote control of Phono 4 is done by connecting 8R63 and 8R64 to chassis potential, thus triggering 8TR15, which goes ON. 8TR15 makes 8TR16 go ON, and the circuit will remain activated.

8D23 blocks the passage of 18 V in the Stand By OFF condition, when 18 V is present at „A“ and „3“ (used in remote control of Stand By). Diodes 8D24 and 8D25 in P5 and P4, respectively, perform the same function.

AUX 2

AUX 2 is identical with Phono 4 except for remote control, to which only one of the two functions can be connected. As supplied from the factory, only Phono 4 is connected to remote control. In order to connect AUX 2, the two resistors 8R63 and 8R64 must be transferred to the AUX 2 circuit on the PC board, which has holes for them.

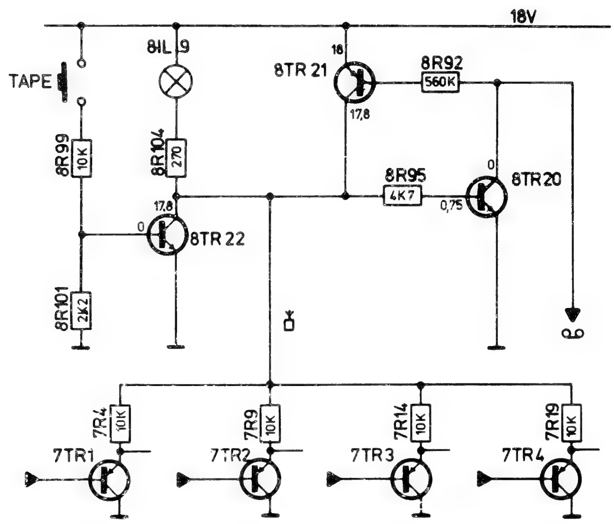
TAPE 4

The Tape circuit of the EL switch differs from the other EL-switch circuits by having two functions:

Either to keep tape monitor transistors 7TR1, 7TR2, 7TR3 and 7TR4 ( ) ON to permit the passage of the FM, AUX, and phono 4 signals,

or to keep tape monitor transistors 7TR5, 7TR6, 7TR7 and 7TR8 ( ) ON to permit the passage of the Tape 4 (in) signal.

The Tape function cannot override the other programmes (FM, Phono 4, AUX, or Stand By ON), but these can override the Tape function.

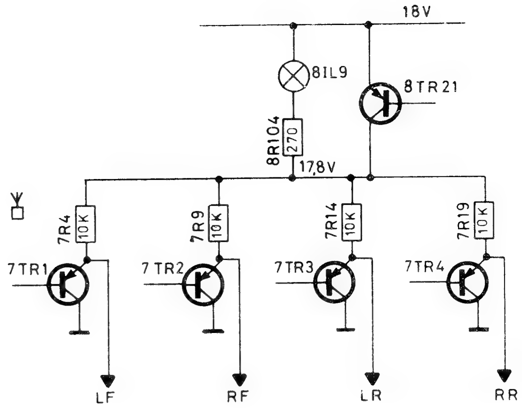


When the receiver is turned on, and goes into Stand By ON, the Tape circuit goes into the condition which keeps tape monitor transistors 7TR1 and 7TR4 inclusive ( ) ON – in other words, the tape circuit applies 18 V to the emitters of 7TR1 to 7TR4 inclusive ( ), causing the transistors to go ON and let's say, the Phono 4 signal pass through.

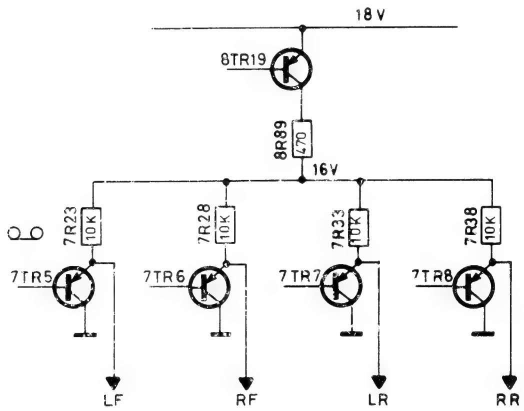
The tape circuit will remain in this condition when one of the programmes (FM, Phono 4, or AUX) is activated.

In the Stand By ON condition or when a programme is switched on, 18 V is present on the supply line. The collector of 8TR22 carries approx. 17.5 V. This voltage is fed through 8R95 to the base of 8TR20, which goes ON, and the collector of 8TR20 will be at zero potential. 8TR21 will go ON too because base resistor 8R92 is connected to chassis potential through 8TR20, providing base current for 8TR21.

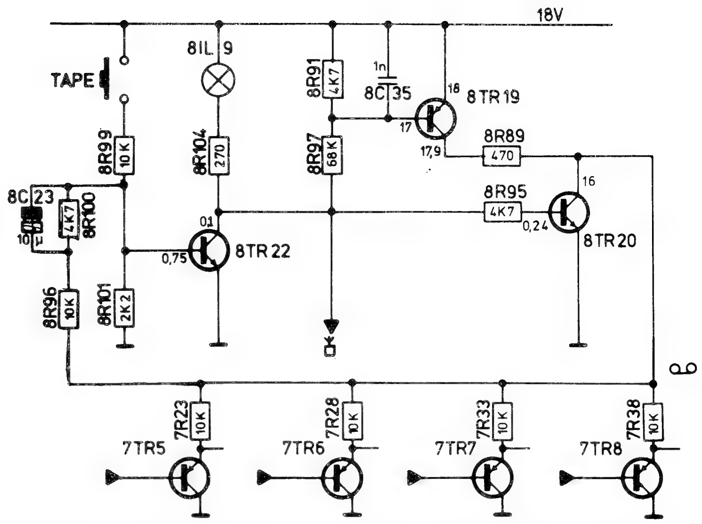
These two transistors will be ON when the tape button is *not* operated, and the circuit delivers 18 V to 7TR1 to 7TR4 inclusive ( ), and 0 V to 7TR5 to 7TR8 inclusive .



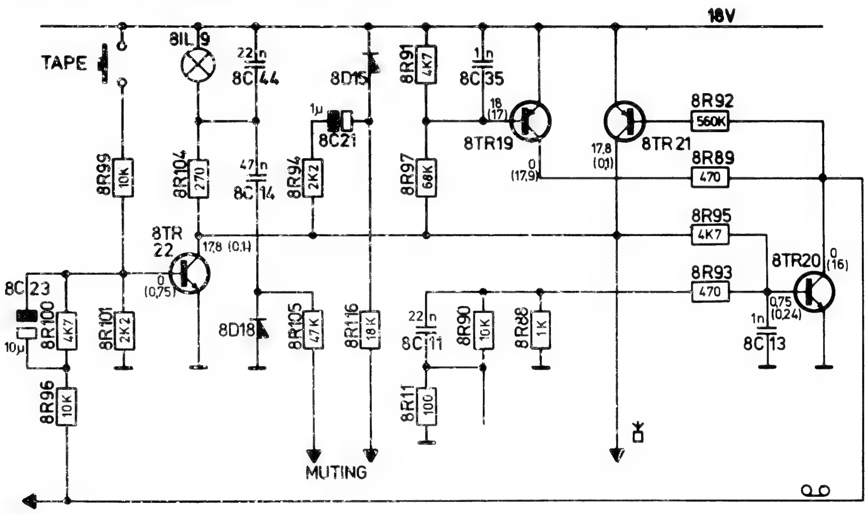
8TR21 must short-circuit the collector impedance 8R104 and 8IL9 (approx. 800 ohms) of 8TR22 when this is OFF i. e. when playing FM, phono 4 or AUX 2.
If the collector impedance was not short-circuited, it would act as a common series resistor for 7TR1 - 2 - 3 - 4 ( ). In that case the mains voltage for 7TR1 - 2 - 3 - 4 ( ) would be too low and the overload security would be too inferior.



The same is true of 7TR5 - 6 - 7 - 8 ( ), when playing tape 4 but as the actual recording/playback technique limits the dynamic range a series resistor 8R89 can be tolerated here.



When the Tape button is operated, voltage is fed to the base of 8TR22, causing it to go ON. The voltage at the base of 8TR19 will drop with respect to the emitter, and 9TR19 will go ON. The circuit will be kept ON because the collector of 8TR19 is connected to the base of 8TR22 by means of 8R89, 8R96 and speed-up network 8C23/ 8R100. In this condition, the Tape circuit will deliver 18 V to 7TR5 to 7TR8 inclusive (ꝏ) and 0 V to 7TR1 to 7TR4 (inclusive ( ).



Nonbracketed voltages: Stand By ON or programme.

Bracketed voltages: Tape ON.

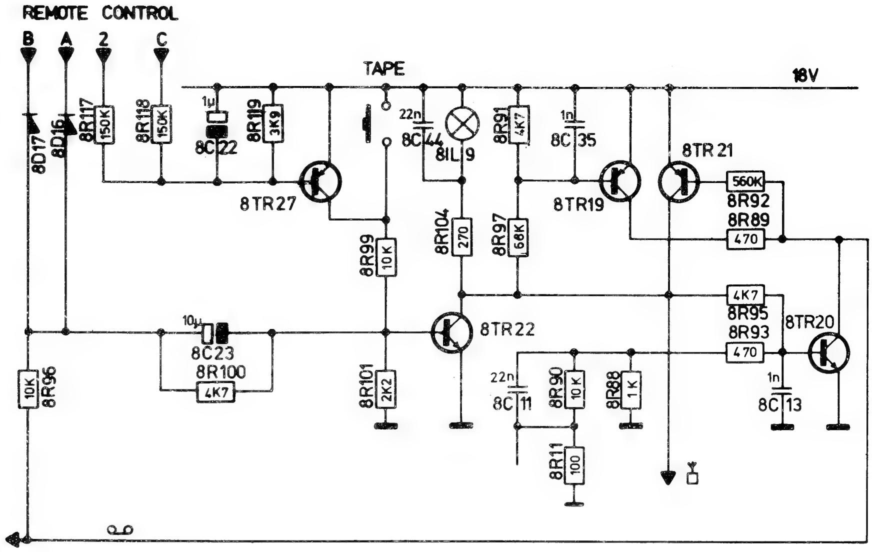
When the Tape button is operated, the function is cancelled when one of the other programme buttons are depressed. If, say, Phono 4 is operated, the voltage across the common emitter resistor 8R11 rises from 3 V to approx. 7 V. The positive voltage pulse is fed via RC network 8R90/8C11 to the base of 8TR20, causing it to go ON. The collector voltage of 8TR20 drops to 0 V, causing 8TR22 and 8TR19 to go OFF.

When the Tape function is turned on and off, the muting circuit is activated from the collector of 8TR22, short-circuiting the signal path to chassis potential while the circuit is being switched.

When the Tape function is turned on, 8TR22 goes ON. The negative-going voltage is fed via RC network 8R94/8C21 to the base of 8TR23, which goes ON and causes muting transistors 7TR9 to 7TR12 inclusive to short-circuit the signal path to chassis potential. When the Tape function is turned off, 8TR22 goes OFF. The positive-going voltage is fed via 8C14 and 8R105 to 8TR24, which likewise causes the muting transistors to go ON.

8D18 and 8D15 are protective diodes to prevent transistors 8TR24 and 8TR23 from receiving excessive reverse bias at their bases during switching.

Remote Control of Tape 4



When Tape 4 is operated from the remote control receiver, 8R117 and 8R118 are connected to chassis potential by a trigger pulse („2" and „C" in the remote control receiver) that makes 8TR27 go ON. As a result of this, the manual switch is short-circuited and 8TR22 and 8TR19 go ON. The circuit is kept ON until another programme is activated.

When Tape 4 is turned off from the remote control receiver, one of the two diodes 8D16 and 8D17 is used. If one of the other programmes is activated, either „A" or „B" will be connected to chassis potential (in the remote control receiver). When either 8D16 or 8D17 is connected to chassis potential, the base of 8TR22 will be connected to chassis potential too, and the transistor will go OFF. The result is that 8TR20 receives base bias from the collector of 8TR22, and 8TR20 and 8TR21 will go ON, turning off the Tape 4 function.

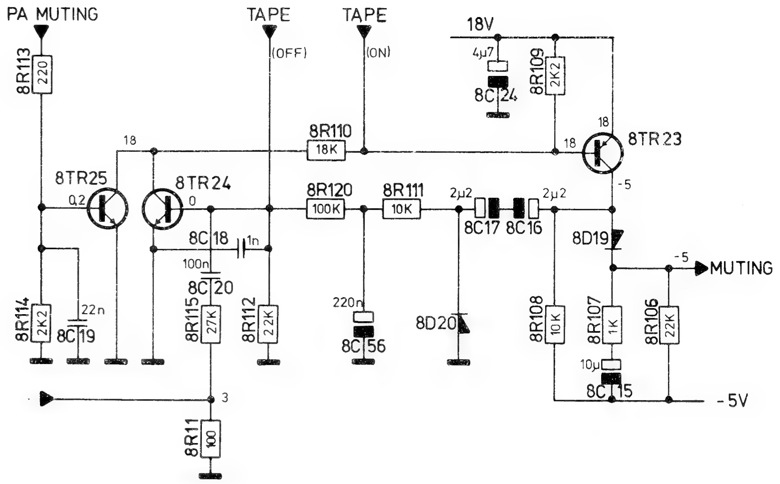
MUTING

The Muting circuit serves the purpose of making muting transistors 7TR9 to 7TR12 inclusive go ON each time it receives a voltage pulse from the EL switch or from the output stage protective circuit.

The muting circuit will receive a voltage pulse in the following situations:

Programme switching
Tape turn on
Tape turn off
Stand By ON and
Output overloading

When a programme button is depressed a second time, the muting circuit will *not* be triggered; it will receive a pulse, but the pulse will not be large enough to trigger the circuit.



When switching programmes, a positive voltage pulse is generated across emitter resistor 8R11. This pulse is fed to the base of 8TR24 via RC network 8R115/8C20. The transistor goes ON, thereby causing 8TR23 to go ON. At the collector of 8TR23 a positive voltage appears which is fed to muting transistors 7TR9 to 7TR12 inclusive, making them go ON for 1/4 second. The length of the interval during which the muting transistors are ON is determined by 8C16/8C17 and 8R120/8R112 in parallel with the base/emitter of 8TR24. The RC network 8R107/8C15 imparts a sloping discharge curve to the position pulse fed to the muting transistors.

8D19 is to separate the two time constant networks 8R107/8C15 and 8R120/8C16–8C17.

8D20 conducts negative voltage peaks resulting from recharging to the electrolytic capacitor to chassis potential so as to prevent 8TR24 from receiving excessive reverse bias.

For „Tape turn on“ a negative-going pulse is fed from the Tape circuit to the base of 8TR23. The transistor goes ON and makes 8TR24 go ON too. The circuit is kept ON for 1/4 second, during which interval it feeds a positive pulse to the muting transistors, causing them to go ON.

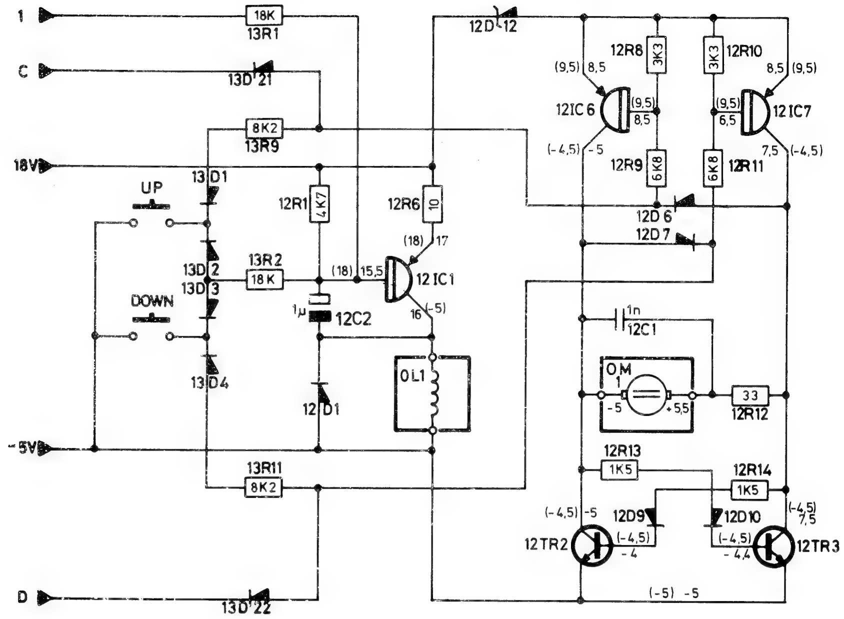
„Tape turn off“ operates in the same manner except that it is 8TR24 which receives a positive-going pulse from the Tape circuit and goes ON.

When Stand By ON is operated, the circuit receives a positive-going pulse from emitter resistor 8R11 (as in the case of programme switching). However, this pulse has no significance because the circuit including 8D22 (as described under „Stand By Circuit") is already operative.

If the output is overloaded, 8TR25 will receive a positive voltage pulse from the output and go ON. This will cause 8TR23 to go ON and transmit a positive voltage from the collector to muting transistors 7TR9 to 7TR12 inclusive, making them go ON. On account of the RC network 8R111/8C56, a brief pulse from the output (< 1 msec) will not make 8TR24 go ON. Consequently the circuit will not be kept ON for 1/4 second as it will during programme switching etc. Muting transistors 7TR9 to 7TR12 inclusive will, in the case of brief overloads (clicks) clip the top off the signal but will not mute the receiver.

POTENTIOMETER OPERATION

The volume, bass, treble, bal. left-right and bal. front-rear potentiometers are operated by a common motor, 0M1. Magnetic clutches 0L1 to 0L5 inclusive transmit drive from the motor to the various potentiometers.



Non-bracketed voltages: Volume down.

Bracketed voltages: Position of rest.

Clutch Control

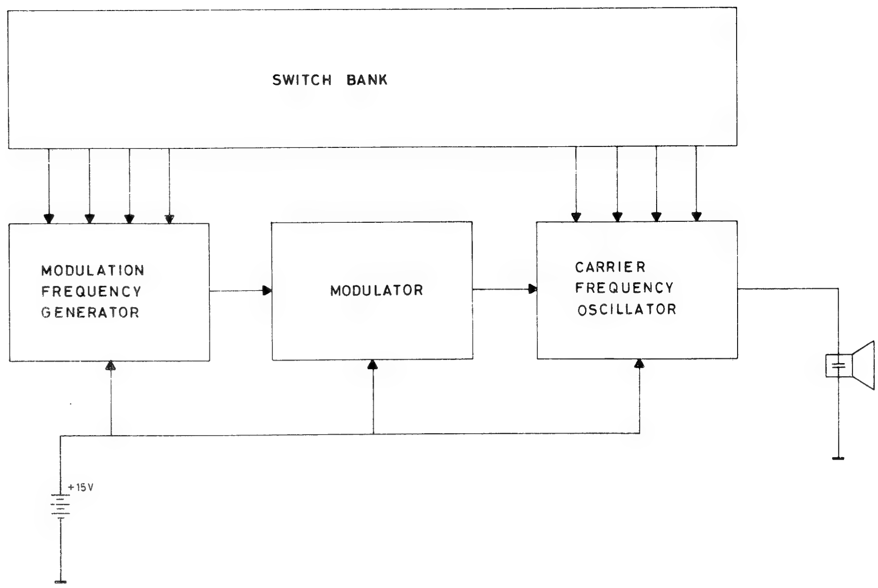
The clutch is activated by 12IC1 going ON. On the „VOL DOWN" switch being operated, the -5 V potential opens up diode 13D3. The voltage at the base of 12IC1 will then drop from 18 V to 15.5 V, with the result that the IC goes ON and 16 V appears at its collector, causing the magnetic clutch 0L1 to operate. The „VOL UP" procedure is identical except that diode 13D2 opens up.

Motor Control

The 5 V potential fed through the „VOL DOWN" switch will likewise open up diode 13D4, and the base of 12IC7 will go from 9.5 V to 6.5 V, and the IC will go ON, causing the collector of 12IC7 to carry 7 V and bias the motor. 12D6 prevents 12IC6 from receiving base bias while 12IC7 is ON. Transistors 12TR2 and 12TR3 when in the no-signal condition will draw a small amount of current, and their collector voltage will be approx. -4.5 V. When 12IC7 goes ON, the base voltage of 12TR2 will drop to -4 V, causing the transistor to go ON, with the result that -5 V is present at its collector. The motor will now receive 10.5 V and pull the volume potentiometer down. 12D10 is to ensure that a possible voltage drop across 12TR2 will not open 12TR3 up.

The operation of „VOL UP" is handled by an identical circuit that will apply bias of opposite polarity to the motor.

COMMANDER TRANSMITTER



As shown in the block diagram, the commander consists of a carrier frequency oscillator, modulation frequency generator, modulator, capacitor microphone, switch bank, and a 15 V battery.

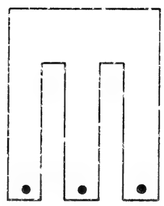
The circuits are built on PC No. 17.

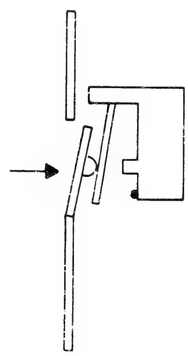
Switch Bank

In practice, the switch bank comprises 14 contact pairs. However, the electrical system comprises 16 possibilities, 2 of which are not utilized.

Each pushbutton must control three switch functions: for the carrier frequency oscillator, modulation frequency generator, and battery voltage.

The three switch functions are handled by the same contact spring (see sketch below), and the mechanical design of the buttons in the top panel secures positive mechanical contact even if a button is pressed the wrong way (oblique pressure).



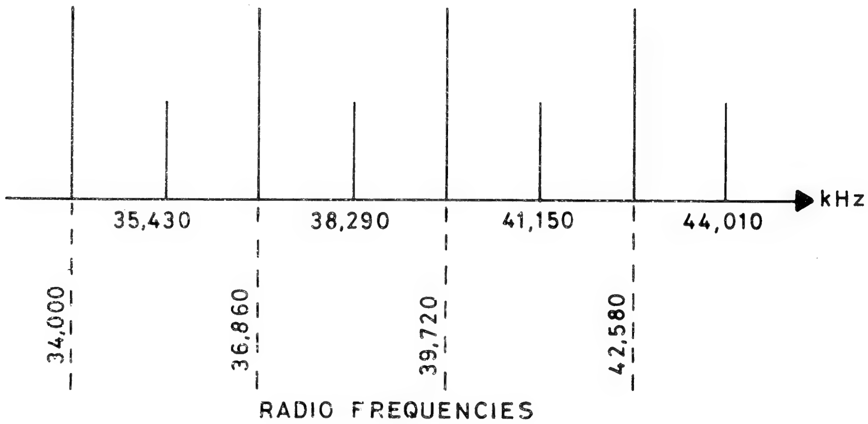


Principle

The commander's carrier frequency is AM-modulated. 100 % modulation of the carrier frequency is employed.

The free-running frequency of the carrier frequency oscillator is higher than 47 kHz. The oscillator is tuned to either 34.000 kHz, 36.860 kHz, 39.720 kHz or 42.580 kHz by activating a contact pair. The separation between the carrier frequencies employed in the commander units for Beovision 6000 type 3910 – 3912 and Beomaster 6000 type 2702 has been chosen with a view to eliminating interaction between units.

Separation between frequencies is 1430 kHz.



Carrier frequencies are given to three decimal places to enable accurate frequency adjustment. As to adjustment, see Section 7, Adjustment Procedure.

The circuit analysis below will state frequencies only to one decimal place in order to preserve the clearness of the sketches employed.

The modulation frequency generator has four fixed frequencies: 148 Hz, 192 Hz, 250 Hz and 330 Hz, selected by operating the respective contact pairs.

The third and last function activated by operating a contact pair is the power supply (+15 V battery).

On the Beomaster 6000 diagram, remote control frequencies are given in figures and letters, in the interest of simplicity.

Carrier frequencies are designated by figures: 1 - 2 - 3 - 4.

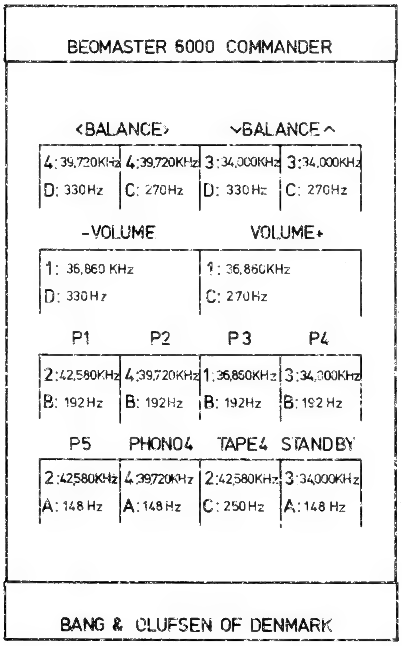
Modulation frequencies are designated by letters: A - B - C - D.

By activating a given set of contacts, the combination of the four carrier frequencies and the four modulation frequencies can be seen in the diagram below.

COMMANDER FUNCTION			BAL. <	BAL. >	BAL. V	BAL. Λ	VOL. −	VOL. +	P1	P2	P3	P4	P5	PHONO 4	TAPE 4	STAND BY	COMMANDER FUNCTION	
PROGRAM		1					1	1			1						36,860 KHz	ULTRASONIC CARRIER
AND		2							2				2		2		42,580 KHz	
MAGNETIC		3			3	3						3				3	34,000KHz	
CLUTCH		4	4	4						4				4			39,720KHz	
PROGRAM AND		A											A	A		A	148 Hz	MODULATION
TAPE RESET		B							B	B	B	B					192 Hz	
MOTOR	UP/TAPE	C		C		C		C							C		250Hz	
	DOWN	D	D		D		D										330Hz	
BATTERY			ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	BATTERY	

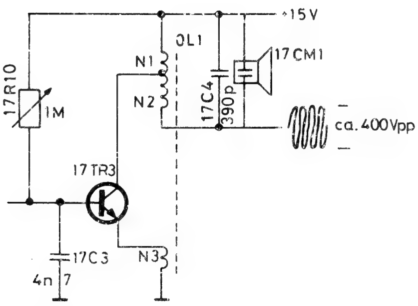
It will appear from the chart that a figure (carrier frequencies) and a letter (modulation) are always required for performing a function.

If a function is activated, say P1 (2-B), all pionts marked 2 and B, both in the receiver and in the diagram, will go towards chassis potential (0 V).



Commander Frequency Distribution Chart

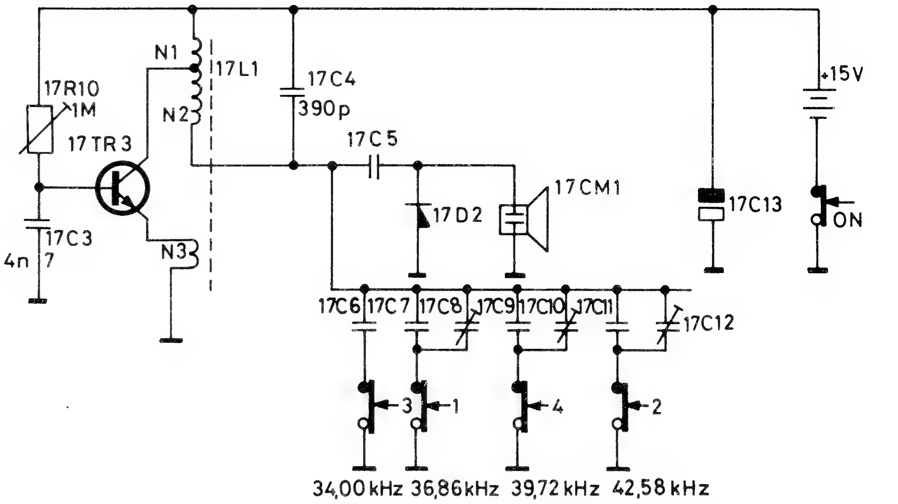
Carrier Frequency Oscillator



The oscillator transistor, 17TR3, operates in Class C. Oscillation is provided by feedback between N1 and N3, the tuning capacitor proper consisting of 17C4 and 17CM1. The capacitors are in parallel across the circuit. Fo is greater than 47 kHz. The microphone capacitance is approx. 90 pF.

Signal voltage at the 17TR3 collector is approx. 30 Vpp. Winding N2 steps the signal up to approx. 400 Vpp.

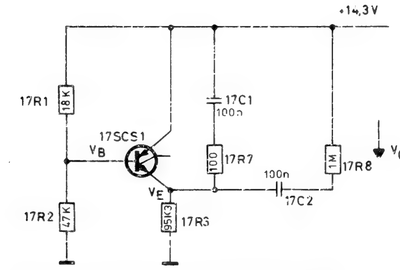
With potentiometer 17R10 the current in the oscillator at the lowest frequency is adjusted to 3.5 mA at 12.5 V supply voltage.



Switches 3, 1, 4 and 2 select oscillator frequencies of 34.000 kHz, 36.860 kHz, 39.720 kHz and 42.580 kHz. S3 shunts 17C6 across 17C4 and 17CM1, AC-wise, thereby tuning the oscillator to 34.000 kHz. Accurate adjustment to frequency is performed with coil 0L1. S1 selects the parallel combination of 17CM1, 17C4, 17C7, and 17C8, thereby tuning the oscillator 36.860 kHz. Accurate adjustment to frequency is performed with 17C8.

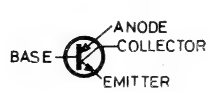
As appears from the diagram section, the frequencies of 36.860 kHz, 39.720 kHz and 42.580 kHz can be fine adjusted with 17C8, 17C10, and 17C12. The resulting oscillator signal, approx. 400 Vpp, is peak rectified by the circuit composed of 17C5 and 17D2. The resulting DC voltage, approx. 200 V, is applied to the capacitor microphone. It is necessary to apply a DC voltage of this magnitude in order to obtain a first-harmonic signal from the microphone.

Modulation Frequency Generator



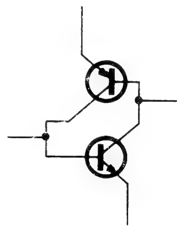
The generator circuit employes a thyristor, 17SCS1.

The thyristor is an SCS type (Silicon Controlled Switch). Thyristor terminal designations are as follows:



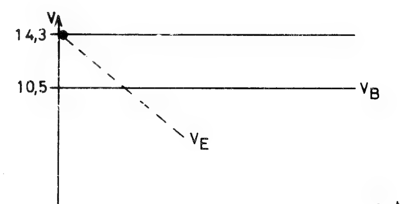
The collector is not used in this circuit.

The thyristor may be regarded as two transistors connected as shown.



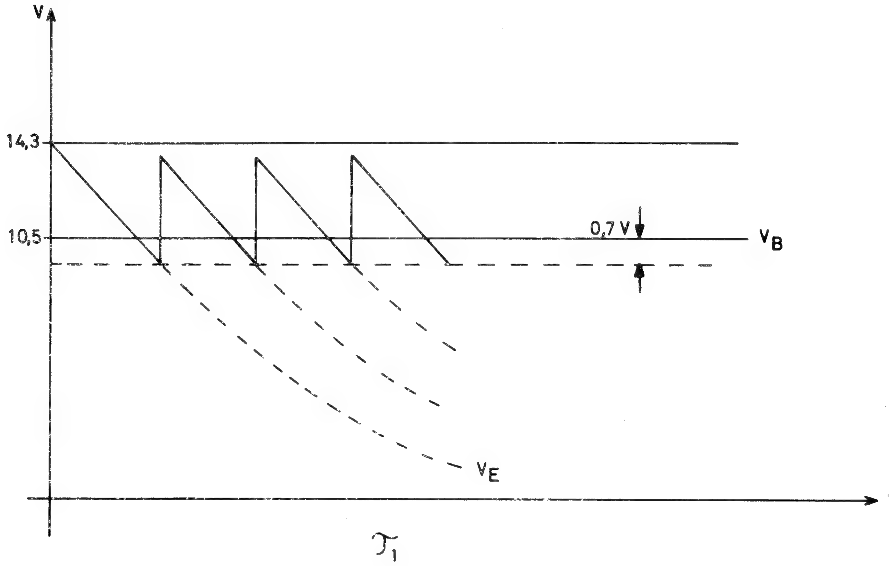
The voltage at the 17SCS1 anode is 14.3 V. Base voltage is 10.5 V, determined by voltage divider 17R1, 17R2.

First, we apply battery voltage, +14.3 V. The moment voltage is applied, 17C1 must be regarded as a short-circuit, and the voltage V_E will then be +14.3 V. The thyristor will then be OFF.



The current in 17C1 begins to decrease, and the voltage across 17C1 increases, following a curve that is determined by the time constant T1 ((17R3 + 17R7) · 17C1). Because the voltage across 17C1 increases, the V_E voltage will drop. The level at the 17SCS emitter is determined partly by the charging of 17C1 and partly by the voltage divider 17R7 and 17R3. When $V_E = V_B - 0.7$ V, 17SCS1 goes ON.

Capacitor 17C1 will now discharge through 17SCS1 following a curve determined by T2 (17R7 · 17C1). Because the charge of 17C1 has now been removed and 17SCS1 goes OFF, the capacitor may again be regarded as a short-circuit, and the process repeats itself.
17R7 limits the current in 17SCS1 when the thyristor goes ON.



A change in T1 ((17R3 + 17R4) · 17C1) will produce a change in the saw-tooth voltage frequency. After approx. one time constant, the voltage across 17R3 has dropped approx. 37 % due to the charging of 17C1. The first portion of the curve is linear.
The 17SCS1 base voltage, V_B, has been chosen so that 17SCS1 goes ON at approx. 1/3 of T1.

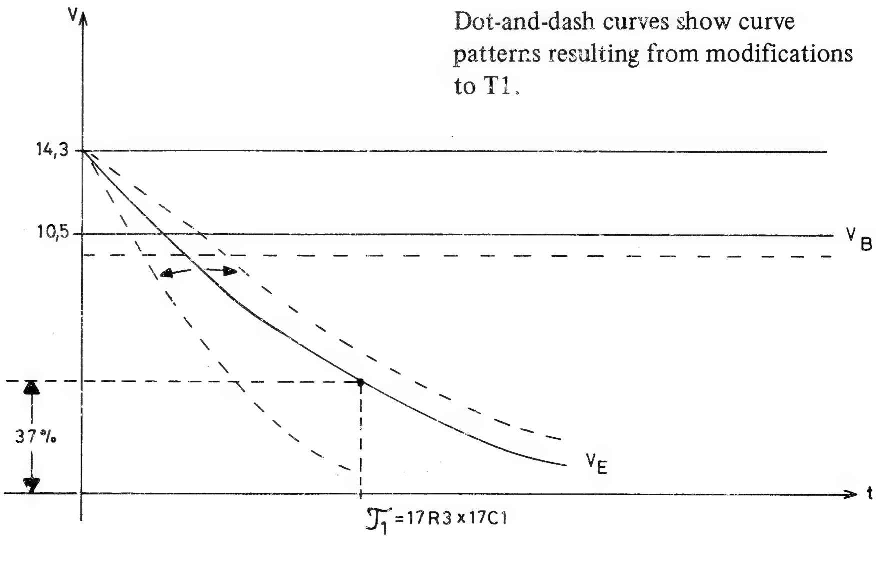
In the following simplified calculation of the generator frequency it will be seen that a change in the value of 17R3 or 17C1 will change the frequency.
Example:

T1 = 95 kΩ · 0.1 μF = 9.5 ms

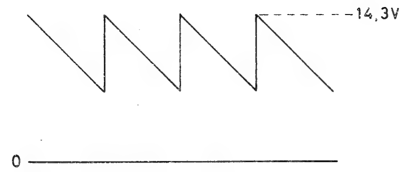
$$1/3\ T1 = \frac{9.5\ \text{ms}}{3} = 3.15\ \text{ms}$$

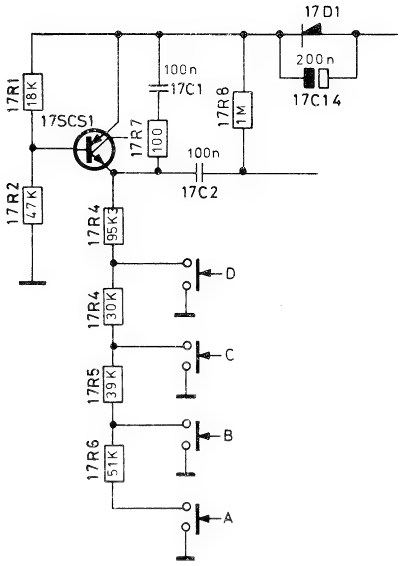
$$Fm = \frac{1}{T} = Fm = \frac{1}{3.15\ \text{ms}} = 320\ \text{Hz}$$

Dot-and-dash curves show curve patterns resulting from modifications to T1.



The voltage at the 17SCS emitter, applied to the modulator via 17C2, has this appearance:

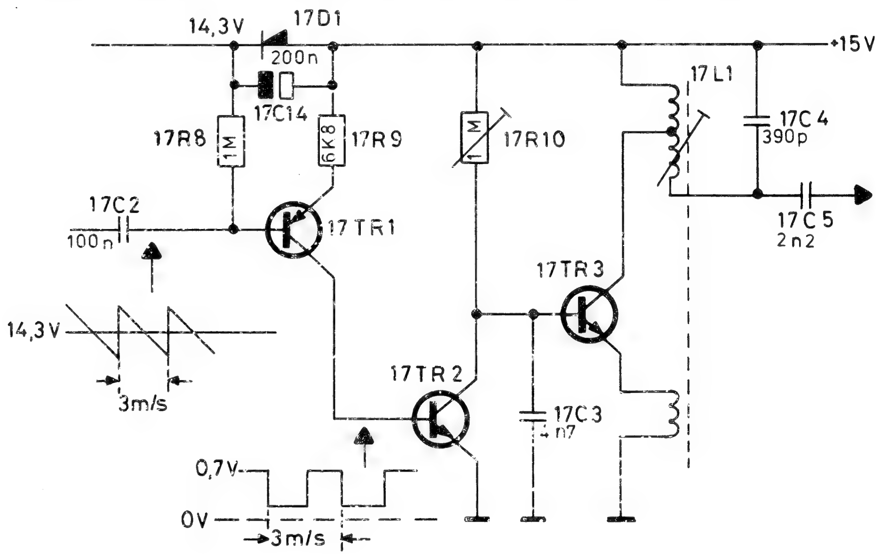




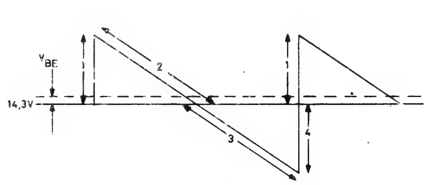
The frequency-determining components of the modulation frequency generator are 17R1, 17R2, 17R3 and 17C1. The generator frequency can be altered merely by altering the value of 17R3.

In practice, the value of the emitter resistor is altered by operating a given contact pair.

MODULATOR



The modulator is built up around the transistors 17TR1 and 17TR2. When the modulation frequency signal is supplied to 17TR1's base, the signal will settle around the DC level on the transistor's base due to 17C2.



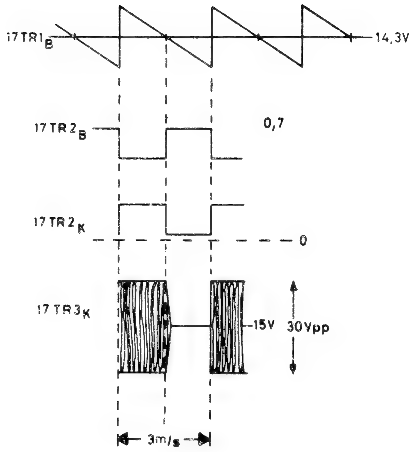
To enable the supplied delta voltage to turn 17TR1 ON/OFF for exactly the same length of time, it is necessary that the transistor's base voltage be 0.7 V below the emitter voltage. In practise, this has been achieved by inserting the diode 17D1 in series with 17R8 and the modulation frequency generator. Thereby it is insured that 17TR1 conducts when the delta voltage goes below 14.3 V, and not when the voltage exceeds 14.3 V. During periods 1 and 2, 17TR1 will be OFF. During periods 3 and 4, the transistor will be ON, and current will flow through 17TR9, 17TR1 and 17TR2. 0.7 V will be present across the base-to-emitter junction of 17TR2 as the transistor will be ON. In other words 17TR2 is on throughout periods 3 and 4, and since this transistor is ON, 17TR3 will be OFF during periods 3 and 4, and the oscillator will stop oscillating.

From this it will be seen that it is during periods 3 and 4 of the modulation frequency signal that is oscillator is modulated 100 %.

Trimmer potentiometer 17R10 controls the emitter current of 17TR3 (the transistor's DC operating point).

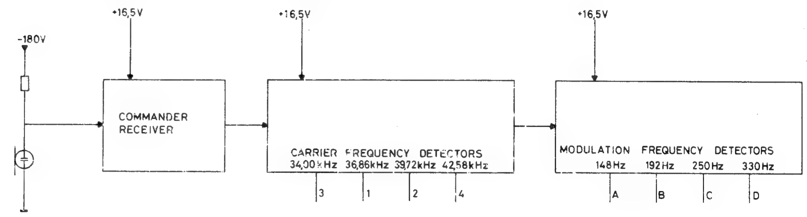
Without a modulation frequency signal applied, a low value of current will flow through 17R10 and the base-to-emitter junction of 17TR3, causing the oscillator to oscillate.

The voltage jump at the 17TR2 collector as a function of modulation therefore determines whether the oscillator will oscillate or not.



NOTE: As will be seen from the carrier frequency signal, the curve does not start towards zero immediately when 17TR2 goes ON. This is due to damped oscillations.

ULTRASONIC RECEIVER



The ultrasonic receiver, carrier frequency and modulation frequency detectors, and matrix circuit are built on PC board No. 14.

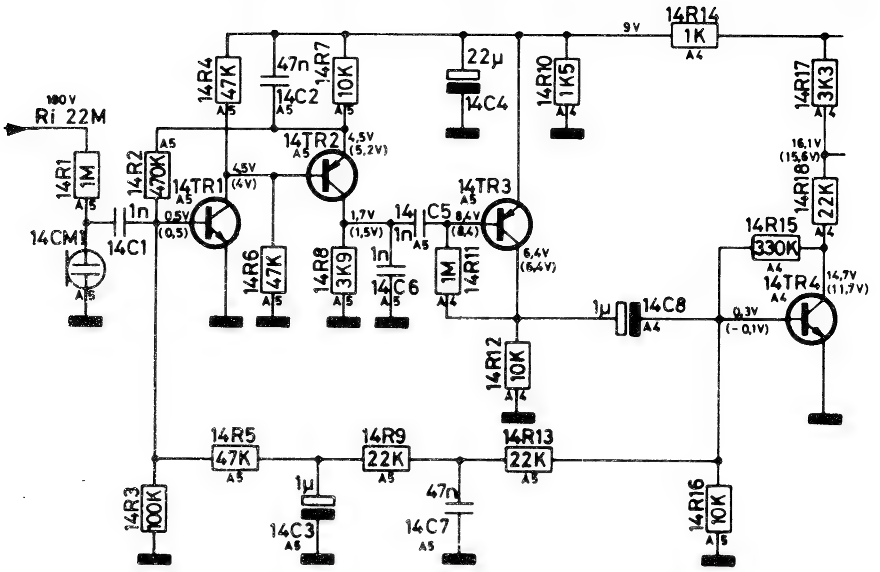
The ultrasonic receiver performs the job of converting the modulated ultrasonic signal transmitted from the commander. The receiver converts the signal into information giving the carrier and modulation frequencies transmitted by the commander.

This information from the receiver is fed to some carrier frequency and modulation frequency detector circuits. The detector circuits must produce two types of information. One is determined by the carrier signal frequency, the other by the modulation frequency.

Receiver

The receiver consists of a bandpass amplifier employing transistors 14TR1, 14TR2 and 14TR3, and an AGC circuit employing 14TR4.

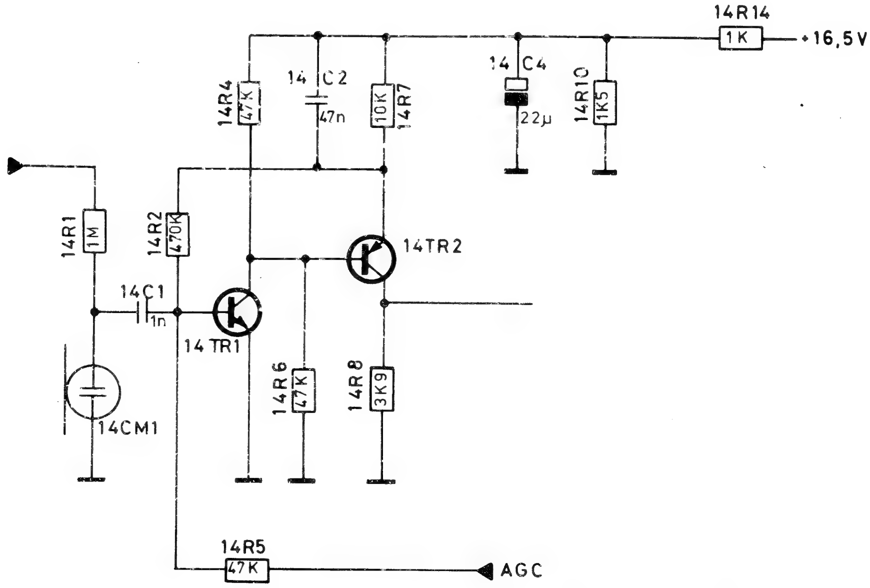
Capacitor microphone 14CM1 converts the ultrasonic signal transmitted from the commander to a change in the base current of 14TR1.



The first two transistors of the receiver, 14TR1 and 14TR2, are connected to operate as a two-stage amplifier. 180 V is applied to the microphone, 14CM1, through 14R1. This voltage is generated in the power supply on PC No. 5

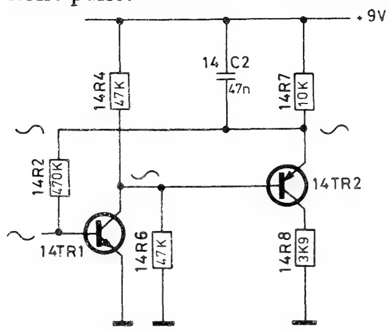
The transmitter signal varies the capacitance of the microphone. The reason for applying a relatively high DC voltage to the microphone is that we want it to deliver the greatest possible signal, for a given capacitance change.

Moreover the receiver is fed with +16.5 V supply voltage from the power supply section on PC No. 5 through 8R98 and plug „remote control" on PC 8. Voltage divider 14R14 and 14R10 reduces the supply voltage for 14TR1, 14TR2 and 14TR3 to approx. 9 V. Capacitor 14C4 is a by-pass capacitor.



In order to reduce the self-noise of 14TR1, this transistor is controlled with a low value of base current, determined by the resistance values of the voltage divider. It should be borne in mind that the self-noise of a transistor depends, among other factors, on the amount of amplification by it.

The amplification and hence the self-noise of 14TR1 must be low to prevent the following carrier frequency and modulation frequency detectors from being activated by some random noise pulse.



The receiver has an AGC circuit which controls the base of 14TR1 through 14R5.

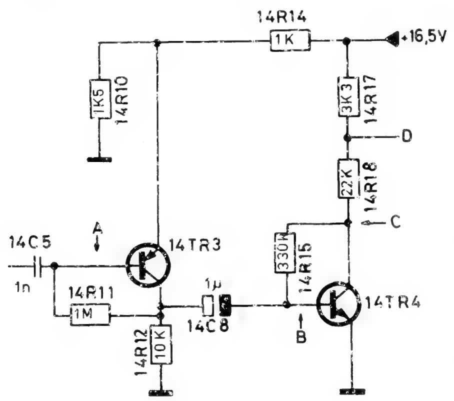
The two-stage amplifier circuit has DC feedback from the emitter of 14TR2 to the base of 14TR1 through 14R2.

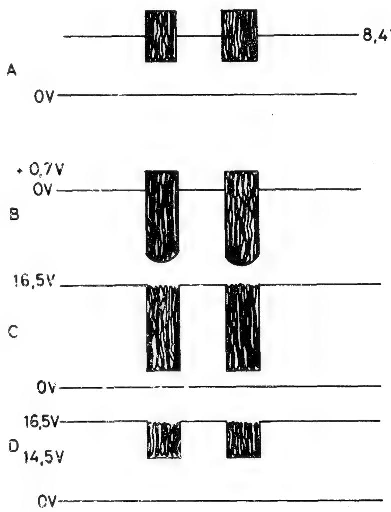
In addition, AC feedback is provided by means of 14C2, the emitter by-pass capacitor of 14TR2.

The bandpass amplifier must be cable of processing the transmitted ultrasonic signals from approx. 35 kHz to approx. 44 kHz. To obtain good noise suppression, frequencies outside this range must be suppressed.

Transistor 14TR3 operates as an amplifier. 14R11 keeps the transistor ON, and the voltage at its base will be 8,4 V.

The supplied signal at 14TR3's base will, due to the DC separation by means of 14C5, settle around the DC level at the transistor's base.





In order to make possible transmission of low-frequency modulation frequencies to the base of 14TR4, 14C8 has relatively high capacitance.
When a signal is present at its base, 14TR4 goes ON, and the positive half of the signal is clamped to chassis potential. A measurement of the signal at the collector of 14TR3 shows that it, too, will be clamped when 14TR4 goes ON. At this instant the voltage at the collector jumps to approx. 0 V. Since the collector resistor is split up into two resistors, the voltage at point D will be determined by the voltage division ratio of 14R17 and 14R18, approx. 1:7. The voltage at point D will then jump from 16,5 V to approx. 14.5 V when 14TR4 goes ON.

The information appearing at point D specifies which carrier frequency and modulation frequency the commander is transmitting at the time in question. This information is fed to the following carrier frequency and modulation frequency detector circuits.

AGC

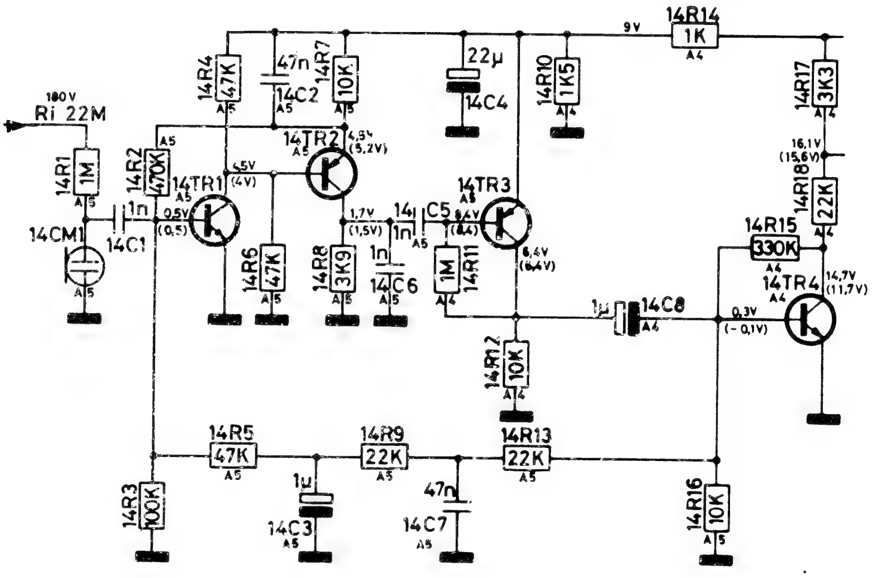
The AGC circuit is composed of 14TR4 and voltage divider 14R5, 14R9, 14R13 and 14R16 and capacitors 14C3 and 14C7.

The base current of 14TR1 is determined by voltage divider 14R7, 14R2 and 14R3 in parallel with the summary of 14R5, 14R9, 14R13 and 14R16. At a given signal level, 14C3 charges to a level determined by the voltage division ratio. This voltage is fed to the base of 14TR1 through 14R5. The positive portion of the signal at the base of 14TR4 is clamped to chassis potential (0.1 V) because the transistor goes ON. At higher signal levels the mean value of the signal at the base of 14TR4 will cause a voltage drop across 14R16, with the result that 14C3 discharges and the voltage at the base of 14TR1 is reduced, and the gain drops.

The voltage at the base of 14TR4 under no-signal conditions is approx. 0.3 V, determined by the voltage divider. In this condition, therefore 14TR4 does not conduct, and the collector voltage equals the supply voltage. Only when a signal reaches the microphone will 14TR4 go ON, enabling the signal to pass through.

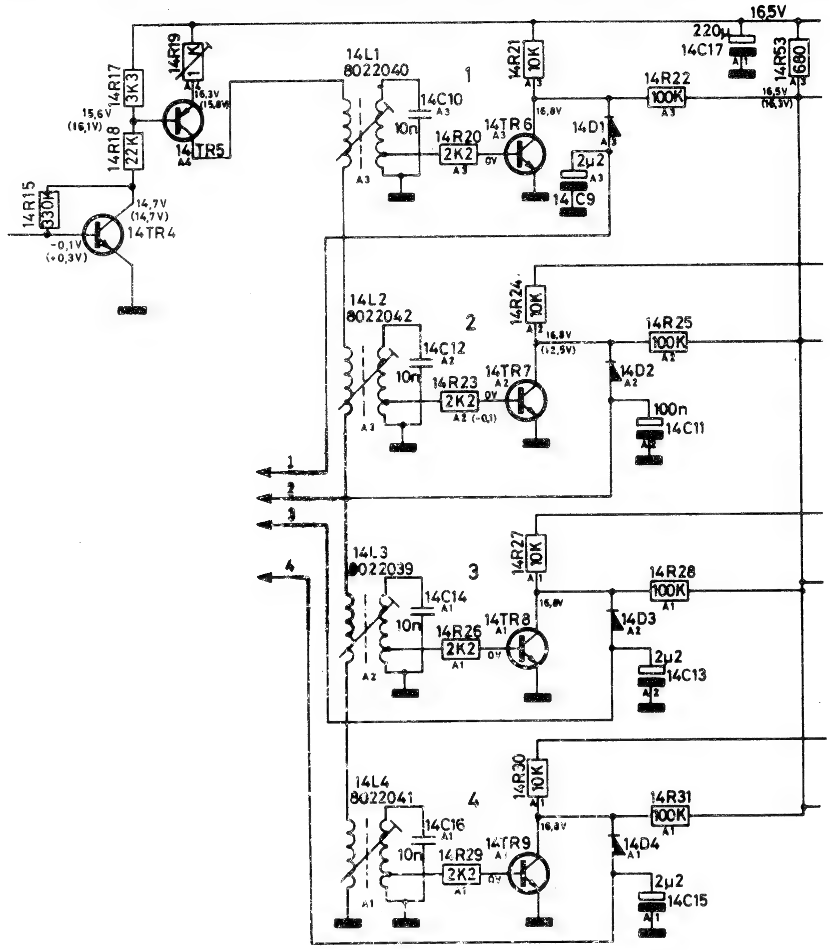
With a signal present, the DC potential at the base of 14TR4 is approx. -1 V, and with an oscilloscope in the DC position, a reading of -0.7 to -2,7 V will be obtained. The reason why a vacuum-tube voltmeter reading of approx. -1 V is obtained at the base of 14TR4 with a signal present is that the mean value of the signal is measured in the DC position.

Capacitor 14C7 is part of a time-constant network to prevent brief noise pulses from activating the AGC circuit.

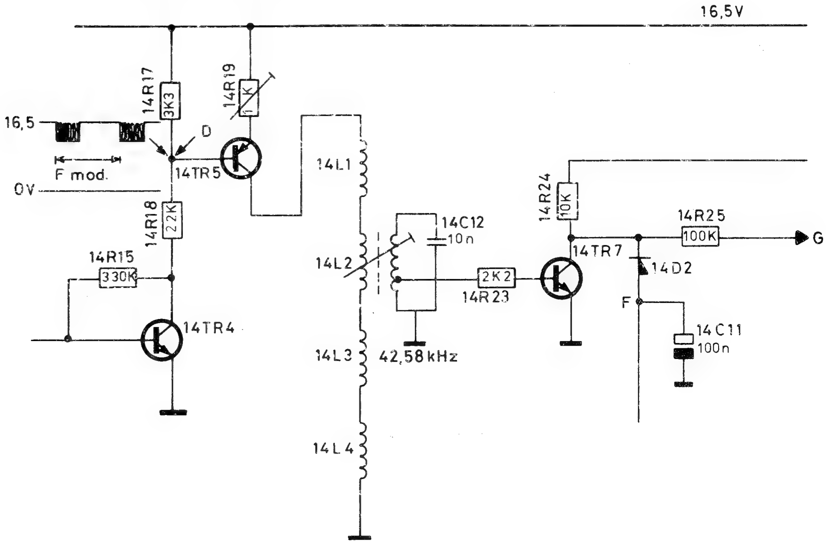


Carrier Frequency Detectors

The carrier frequency detector circuit is composed of four electrically identical circuits which employ transistors 14TR5, 6, 7, 8 and 9. Each detector is tuned to one of the carrier frequencies employed. The circuits convert the carrier frequency signals into voltage jumps which are fed to the electronic switch and regulate circuit.



Since the four detector circuits are electrically identical, the subsequent analysis will deal only with the „2" for 42.58 kHz circuit, consisting of 14L2, 14C2 and 14TR7. 14TR5 functions as a current amplifier. In the collector circuit of 14TR5 are inserted four coils each of which is the primary coil of one of the tuned circuits. Potentiometer 14R19 adjusts the collector current of 14TR5.



As previously stated, the signal at point D contains information about the carrier and modulation frequencies transmitted. The information is shown in Fig. 1.

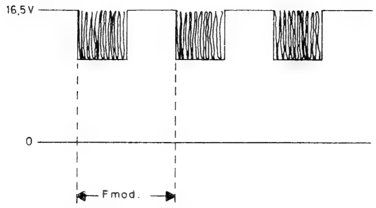


FIG. 1

Fig. 2 shows the same information but viewed over a shorter unit of time.

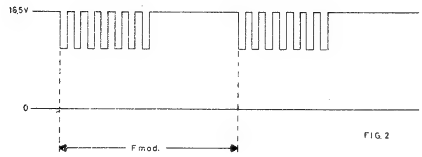
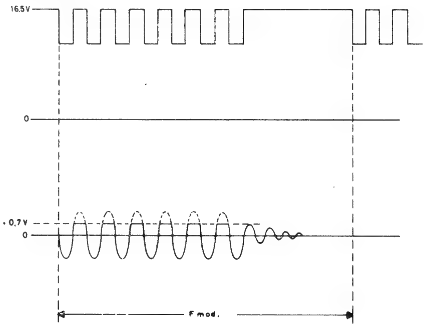


FIG. 2

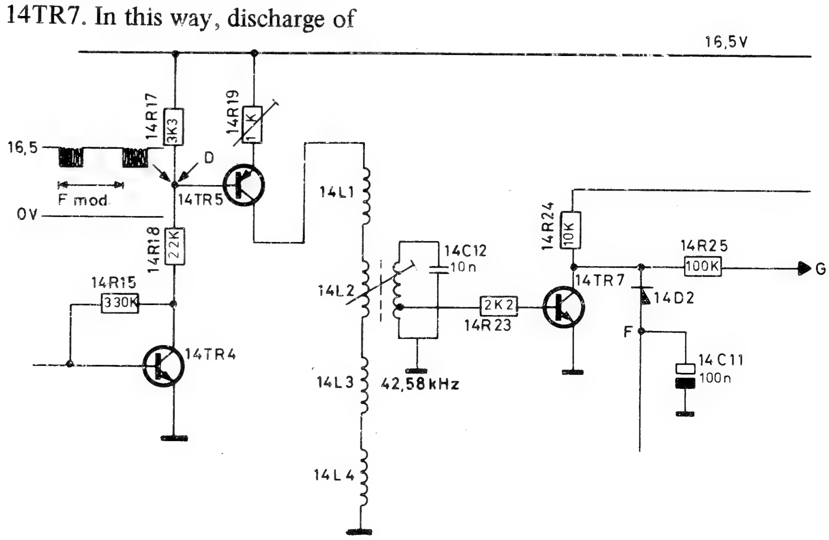
The high-frequency voltage jumps at point D make 14TR5 go ON. In the collector circuit, current pulses occur as a function of the jumps at the base of 14TR5. The oscillatory circuit 14L2, tuned to 42.58 kHz, is activated by the current pulse in the collector circuit of 14TR5, and it shou should be borne in mind that a tuned circuit when activated will start oscillating sinusoidally. 14TR7 is current-controlled at its base via 14R23 from a tap on the circuit. During the positive periods of the oscillations 14TR7 goes ON; and when this occurs, the voltage at the collector will jump from + 17.2 V to 0 V.

The curves below show the information at point D, viewed over an even shorter unit of time than the curve shown in Fig. 2. Also shown is the oscillation of the circuit (14L2) at the base of 14TR7.



When 14TR7 goes ON, activated by the positive periods of the oscillation, current will flow through 14D2, 14C11, and the capacitor will build up a charge. The voltage at the collector of 14TR7 and point F jumps from +17.2 V to approx. 0 V. During the negative periods of the oscillation, 14TR7 goes OFF, and the voltage at the collector jumps from 0 V to +17.2 V whereas the voltage at point F remains approx. 0 V because the diode 14D2 blocks the passage of the negative jumps at the collector of 14TR7. In this way, discharge of 14C11 during the positive periods of the oscillation is avoided, and the voltage at point F is kept at approx. 0 V as long as a signal is transmitted from the commander. The voltage at point F is fed to the electronic switch (P1).

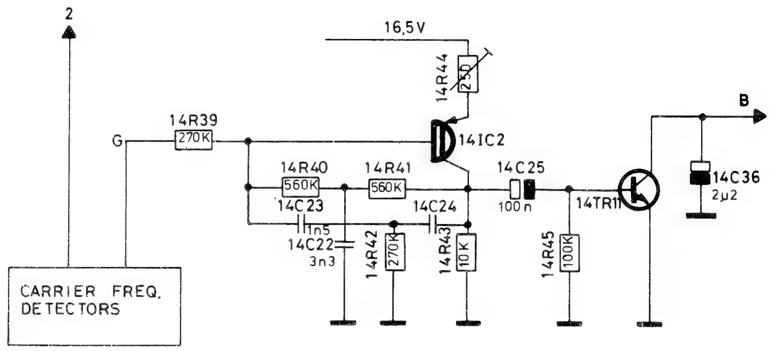
At the junction of the collector resistors of 14TR7 (14R25 and 14R53), information arises which gives the modulation frequency. This information is fed to the modulation frequency detector circuits.



Modulation frequency detectors

The modulation frequency detector circuit comprises four electrically identical circuits employing Darlington transistors 14IC1, 2, 3, 4 and transistors 14TR10, 11, 12 and 13.

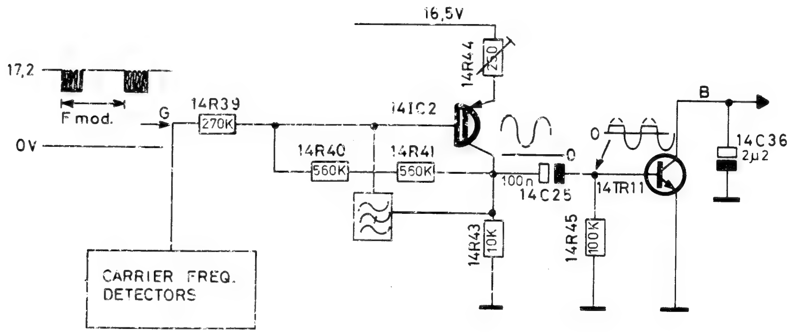
Since the four circuits are electrically identical, the following analysis covers only the 192 Hz „B" circuit, employing 14IC2 and 14TR11.



As stated in connection with the analysis of the carrier frequency detectors, information appears at point G, giving the modulation frequency etc. Resistor 14R53 is common to the carrier frequency detectors and the four modulation frequency detectors.

The detector may be regarded as a selective bandpass filter. The 192 Hz filter is composed of 14R40, 41 and 14C23, 24, 14C22 and 14R42. The filter may be regarded as a feedback loop from the collector of 14IC2 to its base.

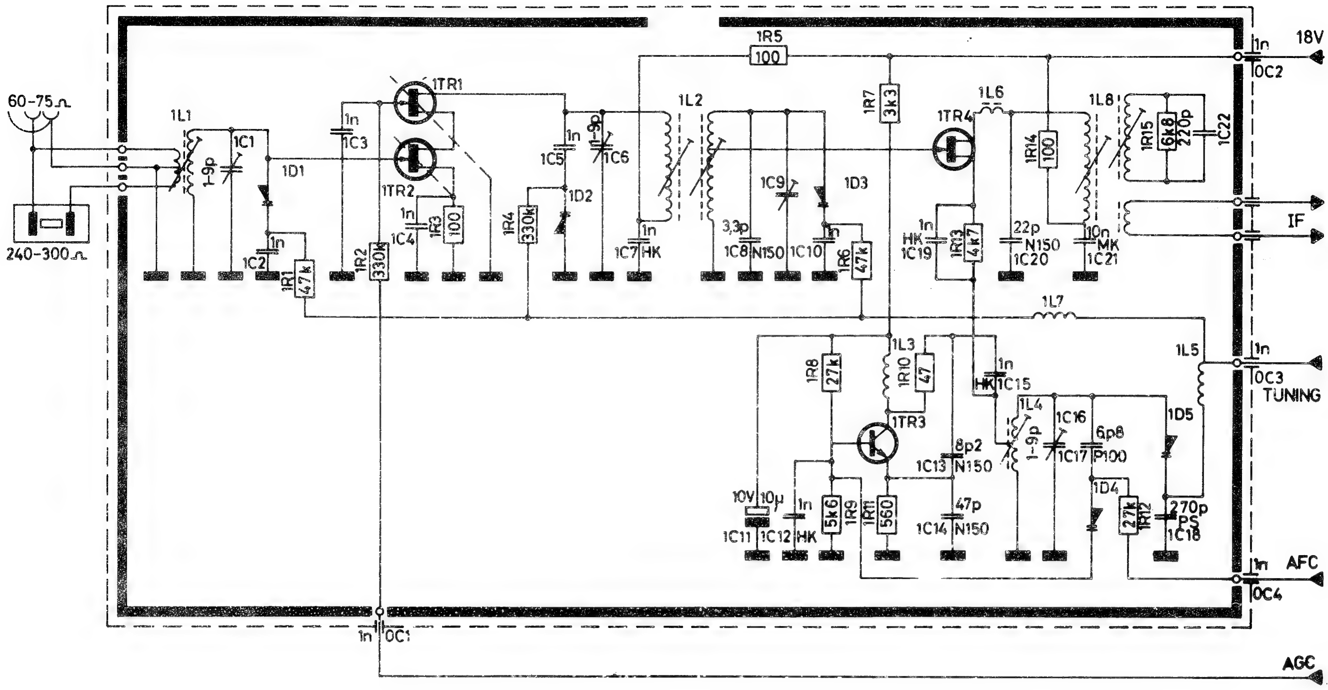
On account of the high selectivity of the filter, the feedback action ceases only at the resonant frequency, at which the impedance in the filter and transistor will be high.



When the filter is fed with it's resonance frequency modulation, an oscillation is initiated across 14R43, which via 14C25 AC-wise, is transferred to the actual detector transistor 14TR11.

The positive half-cycles are clamped to chassis potential (+0.7 V) through the base-emitter junction of 14TR11. When 14TR11 is brought ON, the DC level at point H jumps from 21.7 V to approx. 0 V. This level is applied to the electronic switch circuit. Capacitor 14C36 prevents the modulation from not being fed to the electronic switch circuit. A Darlington transistor is used because of its high current gain.

FM TUNER



The incoming signal is fed via a tuned circuit to the RF stage consisting of two FET transistors in a cascode configuration. This obviates the need for stabilising circuits, and the AGC control system does not affect the input circuit because the incoming signal is applied to 1TR2 and the AGC voltage to 1TR1. The mixer also uses an FET transistor, 1TR4. Signal from the separate oscillator, 1TR3, is fed through an inductive coupling to the source of the mixer transistor, and the amplified incoming signal is fed through a band-pass filter to the gate. The IF signal is taken off at the drain.

Tuning is carried out with four BB103 capacitance diodes and a 100 kohm potentiometer, 0R2. In addition to this „main potentiometer", which covers the entire FM band, five other potentiometers are provided. 9R2 and 9R6 inclusive, also of 100 kohms each, are employed for fixed tuning of P1 to P5 inclusive. These six potentiometers receive 20 V control voltage from the diodes in the EL switch, 8D1, 8D3, 8D5, 8D7, 8D9, 8D11, thus enabling DC tuning of the oscillator and the three RF circuits in the tuner.

Diode 1D4 in the oscillator circuit provides AFC action and is controlled directly from the FM detector.

FM INTERMEDIATE FREQUENCY

The FM amplifier employs ceramic filters and integrated circuits, reducing the number of adjustable circuits to 4. The use of integrated circuits makes possible higher gain in one stage in, addition to providing effective limiting. Each ceramic filter is the equivalent of two tuned circuits. The filter frequency varies between 10.5 MHz and 10.9 MHz, and if replacement is required, all three filters must be replaced because the filters are paired for the same frequency and are not adjustable.

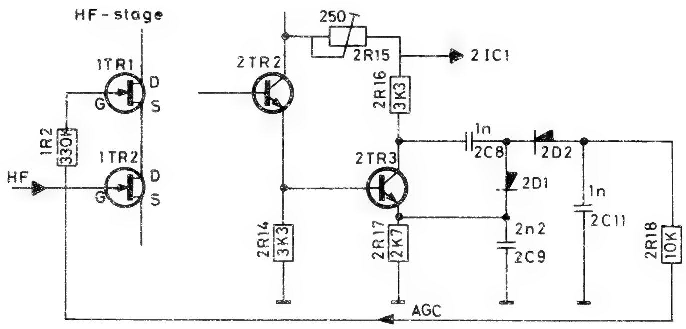
From the tuner, the signal passes to the 1st IF transistor, 2TR1, through a link. The collector circuit comprises ceramic filters which provide attenuation

of the order of 12 dB. From amplifier stage 2TR2/2TR3 the signal is fed to an integrated circuit, 2IC1, which provides a gain of approx. 70 dB. Immediately ahead of 2IC1 is a 250-ohm potentiometer, 2R15, with which the sensitivity can be controlled. Higher resistance gives greater sensitivity but also introduces a risk of instability.

The collector circuit of 2TR4 incorporates the last ceramic filter. This is followed by an integrated circuit, 2IC2, which provides a gain of approx. 28 dB. Potentiometer 2R32 controls the gain of 2IC2.

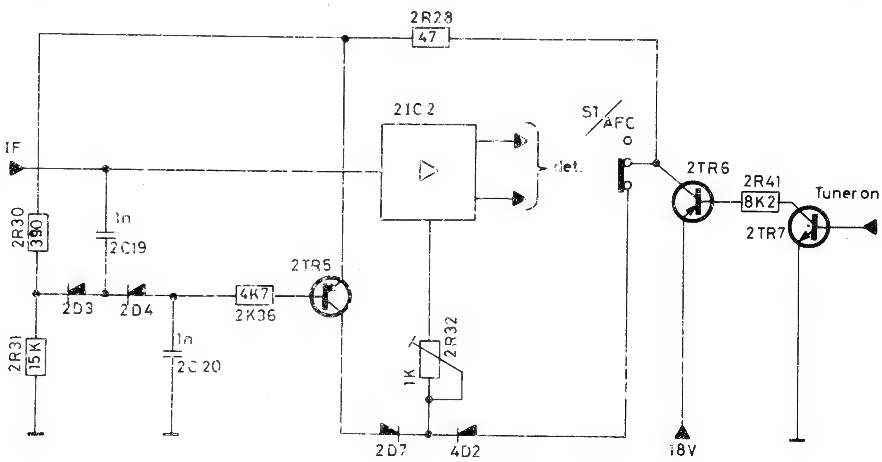
The detector is a symmetrical ratio detector.

AGC Control



Transistor 2TR2 operates as an emitter follower to drive 2TR3. An increase in incoming signal will cause an increase in signal voltage at the collector of 2TR3. This voltage is transmitted to a voltage doubler consisting of diodes 2D1 and 2D2. The rectified negative-going voltage appearing at the anode of 2D2 is fed to the gate of 1TR1. Because this transistor is reverse biased (gate negative with respect to source), the current through 1TR1 will drop, causing lower gain (reverse control).

SILENT TUNING



ST, silent tuning, is obtained by having the supply voltage for 2IC2 keyed by 2TR5.

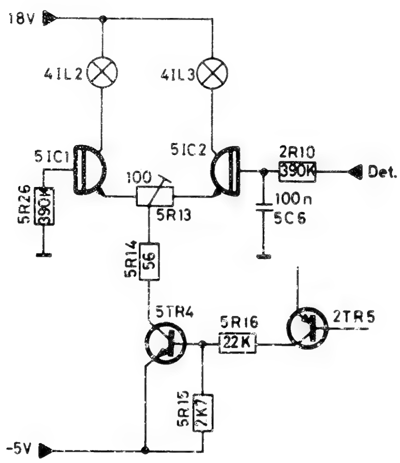
With nonactivated ST, 2IC2 will receive its supply voltage from the collector of 2TR6 through the ST./AFC switch, diode 4D2, and potentiometer 2R32.

With activated ST, 2IC2 will be unable to obtain its supply voltage from the collector of 2TR6, and the receiver will be muted. At incoming signals above 2 μV, the voltage doubler, 2D3/2D4, will furnish sufficient base voltage for 2TR5 to make it go ON, as a result of which 17 V will be present at the collector. The voltage at the collector of 2TR5 is fed through diode 2D7 and potentiometer

2R32 to 2IC2, which admits IF signal to the detector.

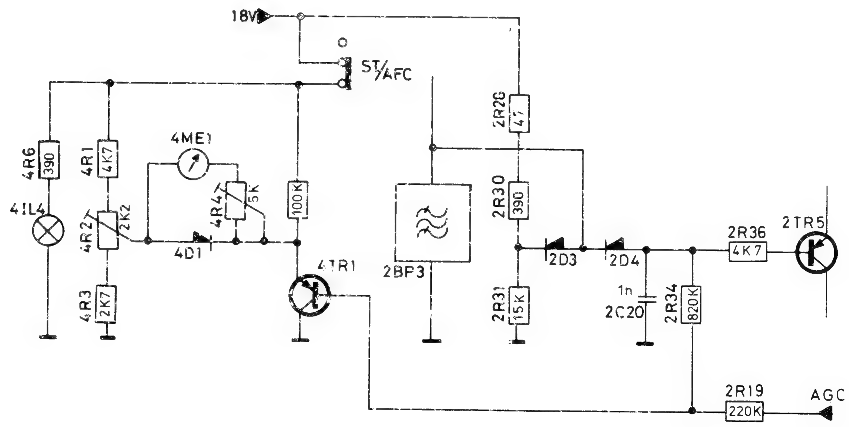
BALANCE LIGHT INDICATOR

The indicator lamps are controlled by two Darlington transistors, 5IC1 and 5IC2. These transistors in their turn are controlled by transistor 5TR4 which is to ensure that the lamps do not light until a signal is present at the receiver input. For this control, 5TR4 receives its base voltage from 2TR5 which as previously mentioned goes ON only when the incoming signal exceeds 2 μV.



Accordingly, 5TR4 goes ON too, and 5IC1 and 5IC2 can draw current. The detector output signal is fed through 2R10 to the base of 5IC2. Transistors 5IC1 and 5IC2 must receive the same base bias when the receiver is tuned accurately to a station (0 V output from the detector). The two transistors will then draw the same current, and the lamps will have equal brilliance. As the tuning is altered away from the station, the 5IC2 base bias will go positive or negative, depending on what portion of the detector curve is tuned in, and the lamps will have dissimilar brilliance. Potentiometer 5R13 enables balance adjustment of lamp brilliance.

TUNING METER



When the incoming signal level increases, the voltage at the filter, 2BP3 will increase too. This voltage is applied to voltage doubler 2D3/2D4. The negative voltage at the anode of 2D4 is applied to the base of 4TR1, causing it to draw higher current and hence making the meter, 4ME1, show a higher reading. Lower values of incoming signal will cause lower meter readings. At very high values of incoming signal, above approx. 30 μV, the AGC bias through 2R19 is used to increase the reading. Diode 4D1 gives the meter an approximated logarithmic indication by shunting the meter.

Operation of ST./AFC causes supply voltage to be removed from 4TR1 and meter lamp 4IL4.

STEREO DECODER

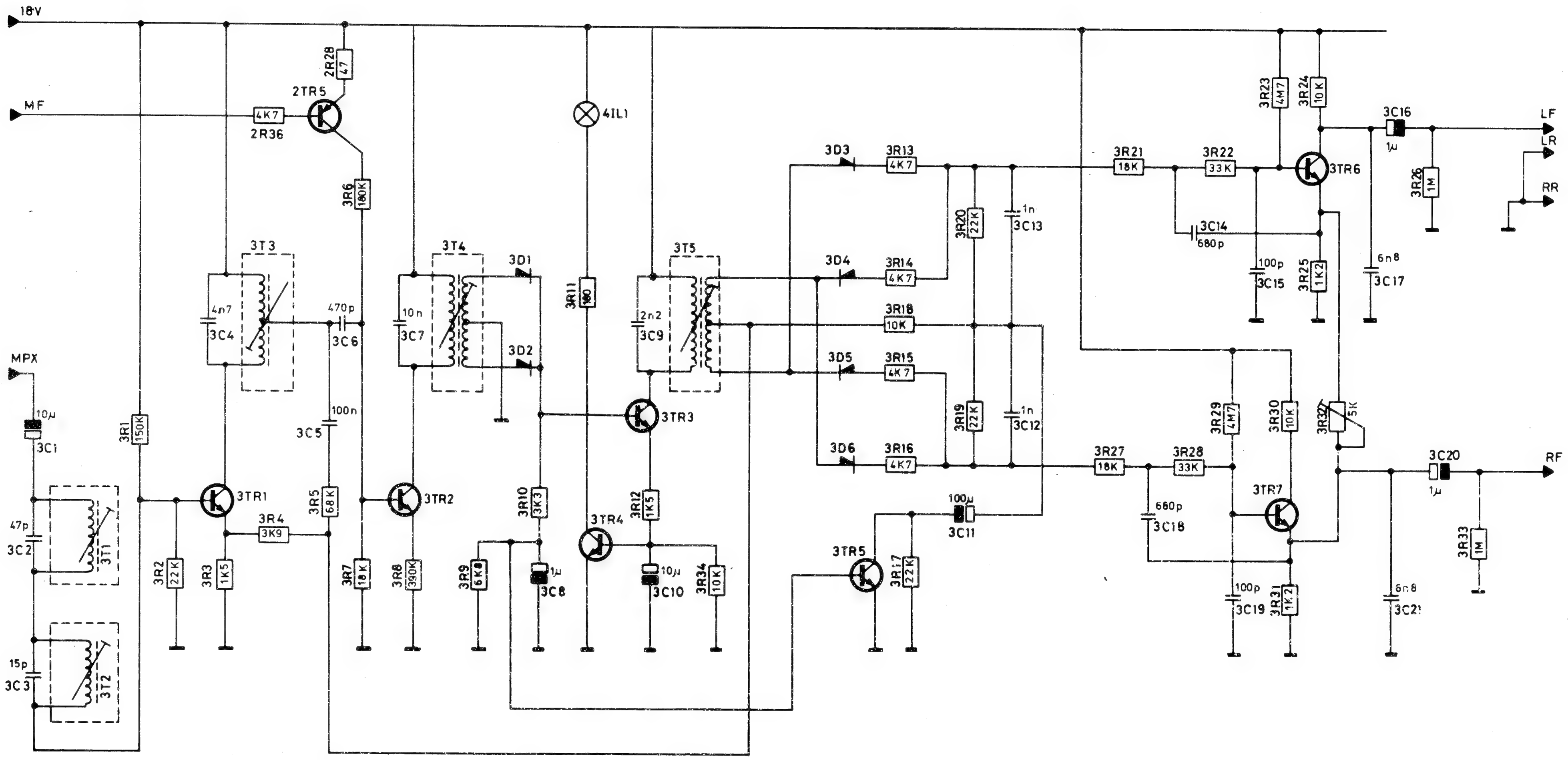
From the FM detector, the signal is fed via parallel traps for the 3rd and 4th harmonics of 38 kHz to the base of 3TR1, from where 19 kHz signal is taken off from a tuned collector circuit. The 19 kHz signal is amplified in 3TR2 and doubled to 38 kHz in full-wave rectifier 3D1/3D2. The 38 kHz signal is amplified in 3TR3 before passing to the ring demodulator for controlling the MPX signal.

The MPX signal is taken off at the emitter of 3TR1 and fed to the midpoint of the ring demodulator secondary circuit. Any rest of 19 kHz signal will be cancelled out by RC network 3C5/3R5, the signal at the collector of 3TR1 being in phase opposition to the signal at the emitter. The left and right channels are restored in the ring demodulator from where the signals pass to separate transistors, 3TR6 and 3TR7, and on to the LF and RF amplifiers through diodes 6D1 and 6D2 (Diagram II). The LR and RR channels are connected to chassis potential on the stereo decoder in preparation for the coming quadraplex system. Potentiometer 3R32 allows the decoder to be adjusted for max. channel separation.

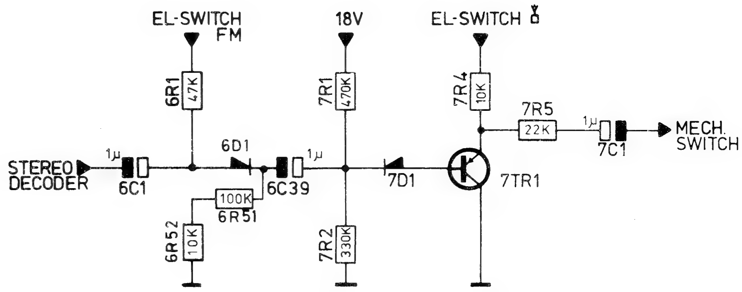
The stereo lamp, 4IL1, lights when transistor 3TR4 receives base bias from the emitter of 3TR3 and goes ON.

Transistor 3TR5 in the case of a stereo signal will act as a short circuit because it is driven by the signal from the full-wave rectifier, thus connecting 3C11 to chassis potential, which means that the midpoint of the ring demodulator is connected to chassis potential. In the case of mono broadcast, 2TR5 will be OFF, acting as a high impedance. The signal will now pass from the emitter of 3TR1 and 3TR7.

During reception of weak FM signals below 2 μV, 2TR5 will not go ON. This means that 3TR2 receives no base bias and goes OFF, 3TR5 will then also go OFF, and the signal is fed around the ring demodulator as a mono signal. 3TR3 and 3TR4 will likewise go OFF, and stereo lamp 4IL1 will turn off.



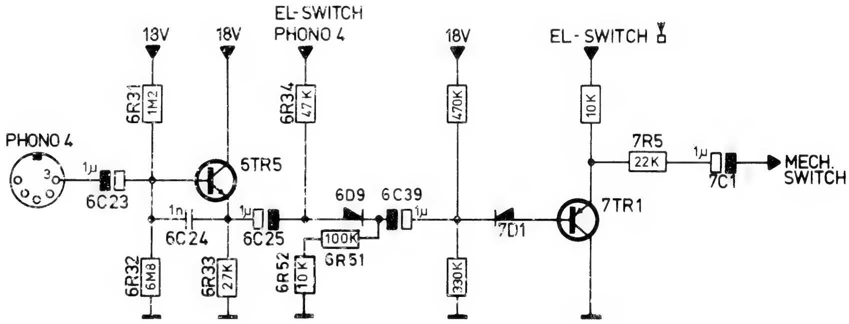
INPUT CIRCUITS



FM

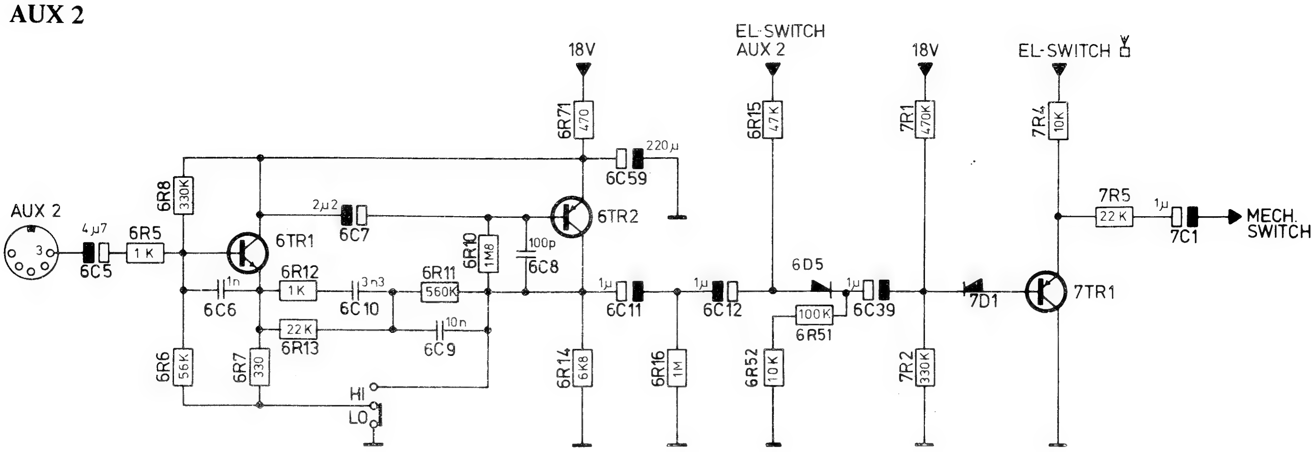
When an FM programme is activated, the signal from the stereo decoder passes through the capacitor, 6C1, to the diode, 6D1, which will be brought to full conduction by 18 V from the EL switch (FM). The signal comes out at the cathode and passes through 6C39 to 7D1. Diode 7D1 protects transistor 7TR1 against the reverse voltage when the transistor is OFF. From the anode of 7D1, the signal goes to 7TR1, which is made conductive by 18 V from the EL switch (⅄). The signal goes out at the emitter, through 7R5 and 7C1, to the mechanical switch.

Phono 4



When Phono 4 is activated, the signal passes from the DIN socket through 6C23 to the base of emitter follower 6TR5. From the transistor, the signal passes through 6C25 to 6D9, made conductive by 18 V from the EL switch (Ω4). From this point on, the signal continues as described under FM.

AUX 2



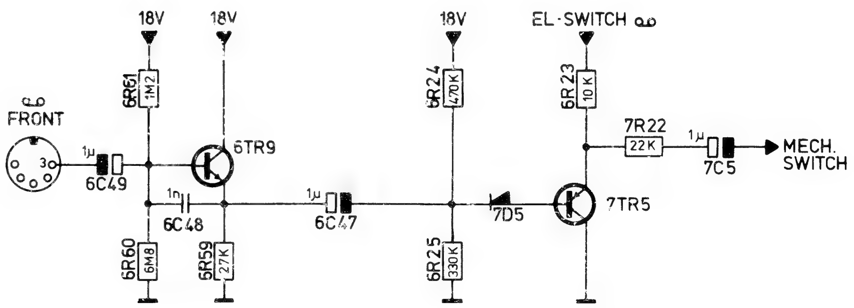
When AUX 2 is operated, the signal passes from the DIN socket through 6C5 and 6R5 to the base of the first transistor, 6TR1, of the RIAA amplifier. The signal appears at the collector and, through 6C7, reaches the base of 6TR2, from whose collector it goes through 6C11 and 6C12 to the diode, which is kept conductive by 18 V from the EL switch (AUX 2). The signal thereafter follows the path described under FM.

The 18 V potential from the EL switch (AUX 2) similarly opens by diodes 6D7 and 6D8, thus causing the signal path in the LR and RR channels to be connected to chassis potential.

With switch 32 in the LO position the signal from the collector of 6TR2 will provide negative feedback for the amplifier stage, applied through the frequency-dependent RC network to the emitter of 6TR1. This results in a frequency response according to the RIAA standard.

With switch 32 in the HI position, the entire signal at the collector of 6TR2 will serve as negative feedback voltage at the emitter of 6TR1, thus reducing the gain in this stage to unity. In the HI position there will also be a signal available at the DIN socket.

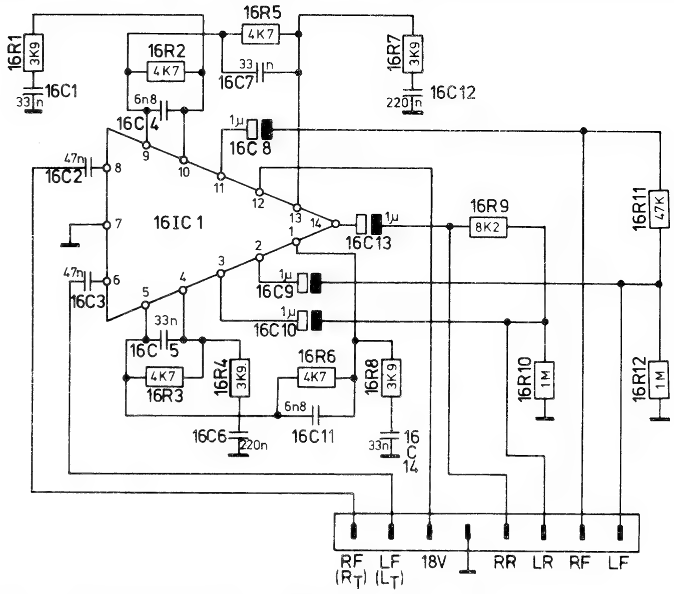
Tape 4



When Tape 4 is operated, the signal passes from the DIN socket (Tape Front) through 6C49 to the base of emitter follower 6TR9. The signal is taken off at the emitter and passes through 6C47 to diode 7D5, which is to protect the following transistor 7TR5 against the reverse voltage when the transistor is OFF. 7TR5 will be ON by means of 18 V from the EL switch (QO). The signal thereafter passes through 7R22 and 7C5 to the mechanical switch.

With 7TR5 ON, 7TR1 in the signal path of the other functions will always be OFF, and vice versa. This makes it possible to make a monitor test (see also the „Tape Monitor“ functional block diagram).

SQ DECODER

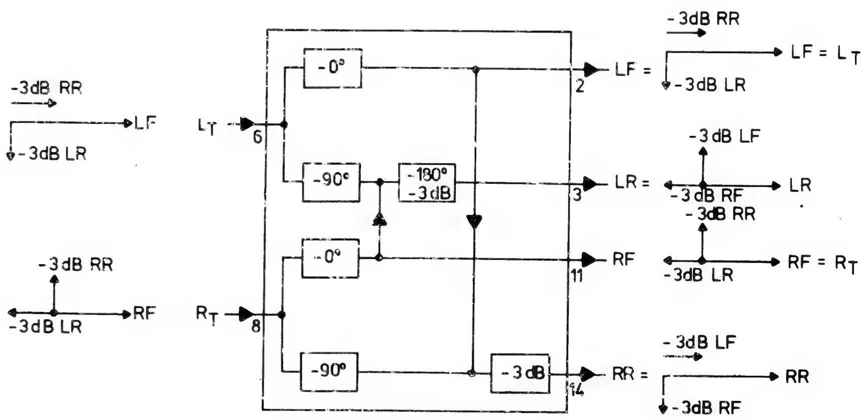


The four original channels from SQ recordings are restored by an integrated SQ decoder. On its way through the receiver, as far as to the SQ decoder, the SQ signal consisted of a stereo signal, LT (left total) and RT (right total). Pin 6 receives LT, and pin 8 receives RT.

LT passes directly through the circuit, becoming LF, at pin 2. RT likewise passes directly through the circuit, becoming RF, at pin 11.

The two rear channels, LR and RR, are generated by phase-shift and attenuation networks, coming out at pins 3 and 14, respectively.

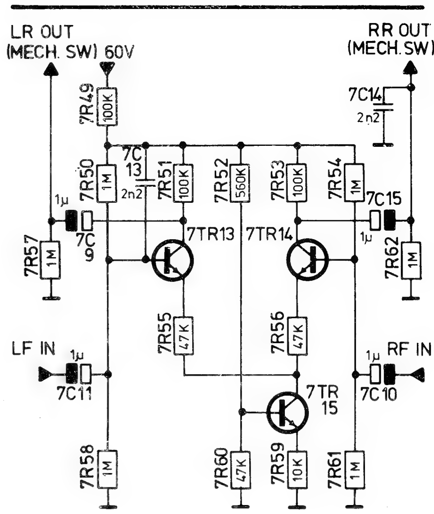
Decoding is illustrated by the following sketch.



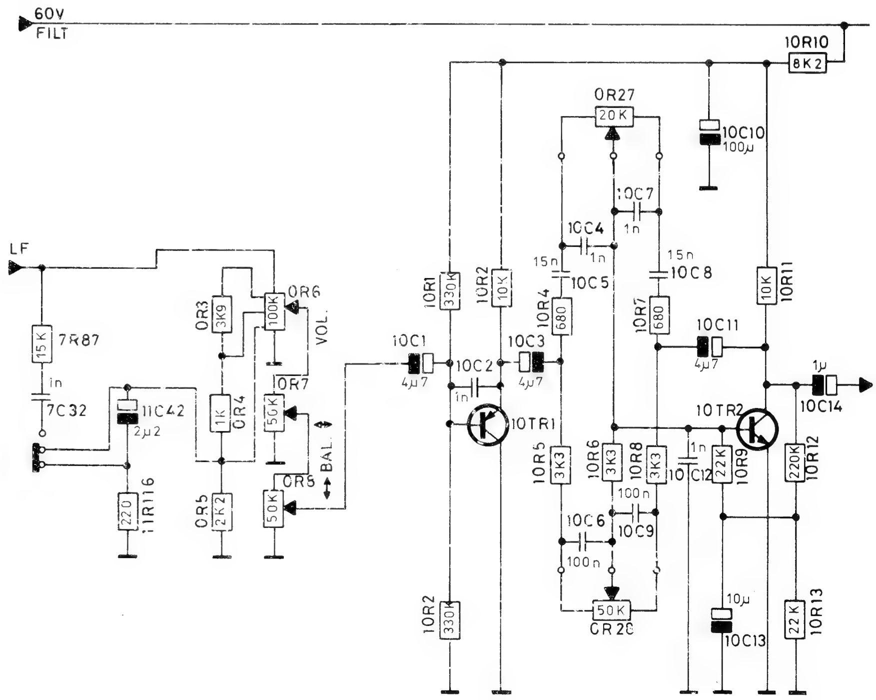
AMBIO DECODERS

The ambio decoder consists of three transistors, 7TR13, 7TR14, and 7TR15.

Transistor 7TR15 sees to it that constant current will flow through 7TR13 and 7TR14. The signal from the front channels, LF and RF, passes to the bases of transistors 7TR13 and 7TR14. If a positive signal from the LF channel reaches the base of 7TR13, the voltage across the emitter resistor 7R55 will increase; hence the current will increase too, and the collector will go negative. When the current increases in 7R55, it will drop in 7R56 as the total current through the two emitter resistors is kept constant by 7TR15. If the current in 7R56 drops, the voltage across collector resistor 7R53 will also drop and the collector will go positive. The signals at the collectors of 7TR13 and 7TR14, which are in phase opposition, pass through the mechanical switch to output amplifiers LR and RR. If a positive signal is simultaneously fed to the base of 7TR14, 7R56 will drain some of the total current through the emitter resistors, and the signal at the collectors will be smaller. With a negative signal at the base of 7TR14 the signal at the collectors will be larger.



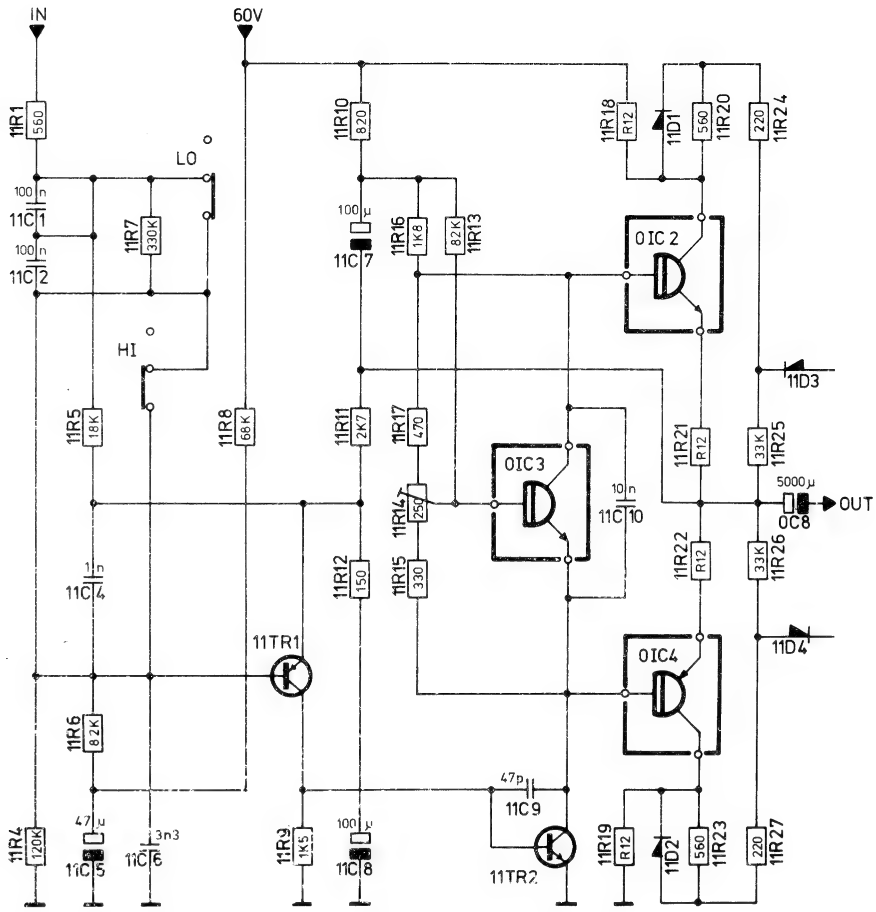
LEVEL AMPLIFIER AND TONE AMPLIFIER



From the mechanical switch, the signal passes to 7TR16 and, via 7TR17, to volume potentiometer 0R6. The potentiometer has a loudness tap which can be switched in and out with the loudness switch. The signal thereafter passes through the potentiometers, 0R7 for balance (left-right) and 0R8 for balance (front-rear) to the tone amplifier.

10TR1 operates as an emitter follower with its collector earthed. The signal passes from 10TR1 to the treble and bass controls, 0R27 and 0R28. From the tone controls the signal passes to 10TR2 from whose collector it reaches the output amplifier.

OUTPUT AMPLIFIER



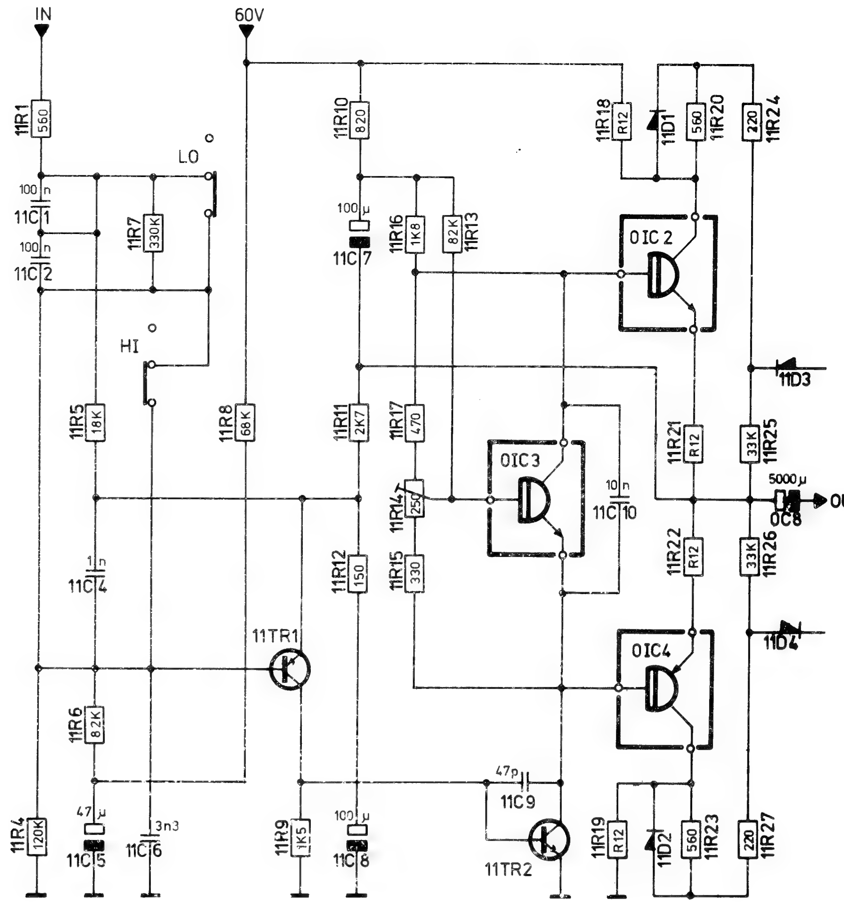
Signal is fed to the output amplifier, LF, through 11R1 from where it passes on to capacitor 11C1 and 11C2 which combine with 11R5 to form an active high-pass filter (LO filter). The filter cuts off at the rate of 12 dB per octave from 80 Hz and down. Resistor 11R7 prevents clicking noise in the event of a DC voltage building up across the capacitors. The signal passes on to the base of 11TR1. The HI-filter switch is used only in the rear channels, where the „LR“ low-pass filter consists of 11R29, 11R30 and 11C13. This filter cuts off at the rate of 12 dB per octave from 6 kHz and up.

With a positive-going signal at the base of 11TR1 the current through the transistor will drop, and the base voltage of 11TR2 will drop since its base is connected to the collector of 11TR1. As a result of this, the current through 11TR2 will drop, and the bases of OIC2 and OIC4 are pulled in the positive direction by 11R10, 11R16 and OIC3. Transistor OIC2 will start conducting, pulling the midpoint (the output) in the positive direction.

Negative feedback is applied to the output amplifier by feeding the signal at the midpoint back through 11R11 to the emitter of 11TR1. This signal will be positive-going, as will the signal at the base of 11TR1, and so reduce the gain of 11TR1. The voltage divider, 11R11/11R12, provides division of the feedback signal so that the gain of 11TR1 will be approx. 20.

The LF and RF channels are identical, as are LR and RR.

No-signal Current



The output transistor, OIC2, will draw base current through 11R10 and 11R16. If OIC3 draws no current, the current flowing out of the base of OIC4 will equal the current in OIC2. This current flows down through 11TR2. OIC3, connected between the bases of OIC2 and OIC4, prevents flow of excessive current through the output transistors. OIC3 will then shunt off some of the current that would otherwise flow as base current in OIC2 and OIC4, the voltage at the bases of the output transistors being fed through the voltage divider composed of 11R17, 11R14, and 11R15 to the base of OIC3. An increase in voltage between the bases of OIC2 and OIC4 will be followed by an increase in base bias of OIC3. OIC3 will then draw more current, shunting a greater share of the base currents of the output transistors. No-signal current is adjusted with 11R14.

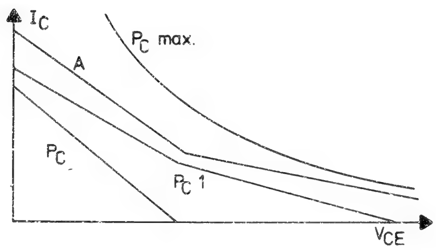
If the output transistors, OIC2 and OIC4, run hot, their emitter-to-base voltages will decrease by 2.5 mV per degree Centigrade. If the base voltage were kept constant, higher current would flow through the output transistors, but in order to prevent this OIC3 is mounted on the heat sink so that it will reach the same temperature as the output transistors. With increasing temperature OIC3 too will draw more current, thus automatically reducing the base voltages of the output transistors and hence the current through the output stage.

A drop in the 60 V supply voltage will cause less current to flow through 11R10 and 11R16, resulting in lower no-signal current. To prevent this, OIC3 receives some of its base current through 11R13 and its base current will therefore be lower when a drop in the +60 V potential occurs. This reduces the shunting of the bases of OIC2 and OIC4, resulting in compensation of supply-voltage variations.

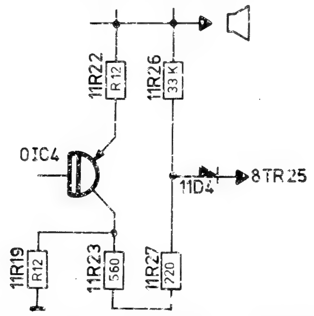
Output Protection

For an ohmic load, the theoretical performance curve, PC, of the output transistors (collector current as a function of collector voltage) will have the appearance indicated by the line PC. With a speaker load, the transistors will not operate on a line but in an area of some size, within the line PC1.

The line „PC max." denotes maximum permissible loading of the transistors, and if this is exceeded, the transistors will be ruined.



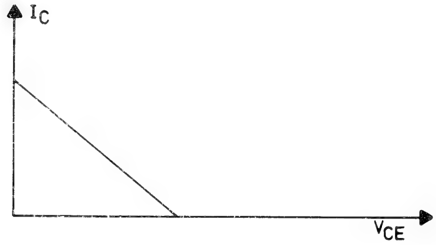
To prevent this a circuit has been inserted to protect the output stage against overloads. The line „A" is the performance line at which the protective circuit is to function.



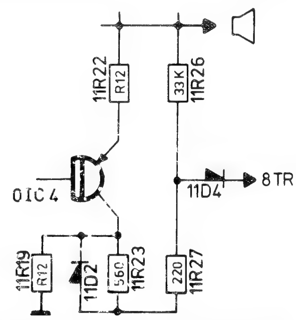
The mode of operation is as follows: When 0IC4 is overloaded, diode 11D4 transmits a positive pulse to the muting circuit, which keys the overload (the signal) to chassis potential.

Voltage for the diode is obtained from the voltage divider composed of 11R26 from the midpoint and 11R27 and 11R23 from the collector of 0IC4. To the voltage from the divider is added the voltage appearing across 11R19 when 0IC4 draws current. If the voltage at the anode exceeds the forward voltage of the diode, a positive pulse will appear at the cathode and pass to the base of 8TR25 in the muting circuit. 8TR25 will go ON, activating transistors 7TR9, 7TR10, 7TR11 and 7TR12. This will connect the signal, and hence the overloading of the output, to chassis potential.

The protective circuit will have a performance curve as illustrated in the sketch below.



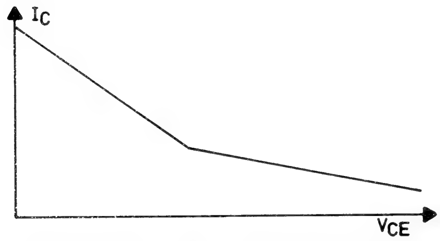
However, this performance curve is not ideal because while it does allow the transistor to draw heavy current at low voltages, it does not allow it to draw low current at high voltages.



By inserting the diode 11D2 the advantage is obtained that the transistor, at a high voltage at the midpoint and hence across the transistor, can draw a low value of current. Diode 11D2 will conduct when a high voltage is present across the transistor, thus short-circuiting 11R23. This alters the voltage-division ratio.

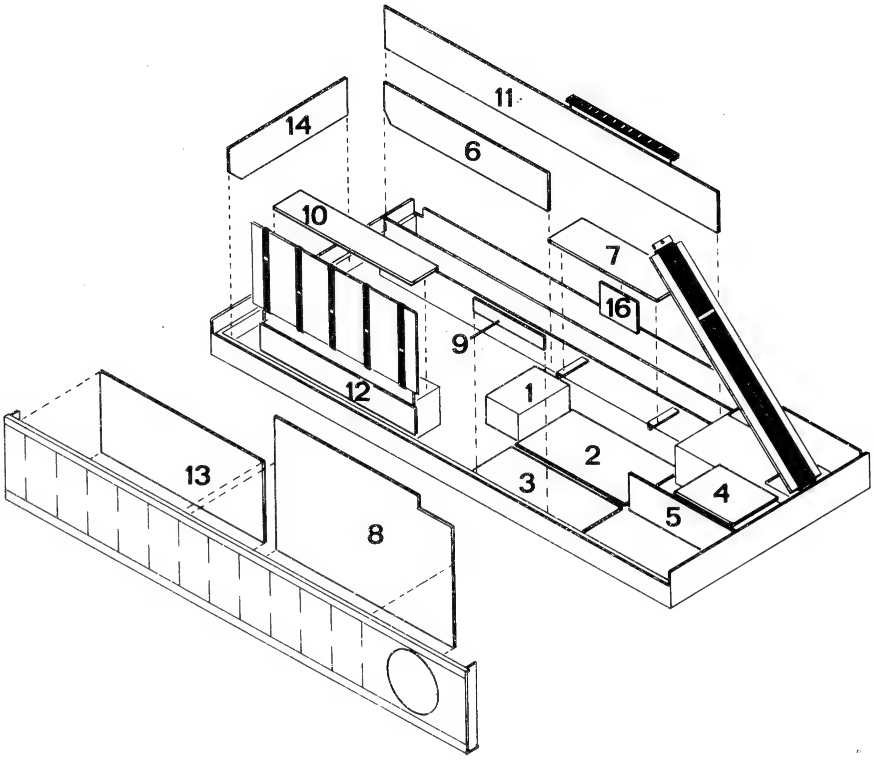
Voltage for 11D4 is now obtained by means of 11R26 from the midpoint and 11R27 from the collector of 0IC4.

The result is that the voltage across 11R19 and 11D2 is added to the voltage from the divider, and the performance curve for the protective circuit will be as shown in the sketch below. This curve follows the transistor's PC max. closely.



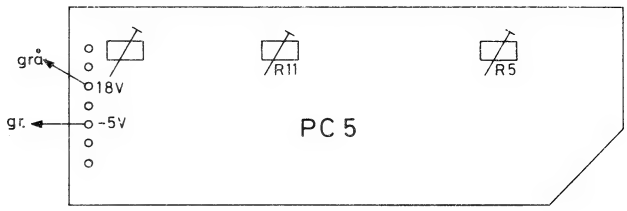
A similar circuit protects the other half of the output, 0IC2. But the pulses from the diode, 11D3, will be negative. Hence these pulses are fed to the base of 11TR9, which goes ON and consequently will have a positive pulse at its collector. This pulse, like the pulse from 11D4, goes to the base of 8TR25 in the muting circuit.

LIST OF CIRCUITS, WITH PC BOARD AND DIAGRAMM NUMBERS



Tuner	PC No. 1	D No. 1
IF section	PC No. 2	D No. 1
Decoder and relay trigger circuit	PC No. 3	D No. 1
Indicator circuit	PC No. 4	D No. 1
Power supply section	PC No. 5	D No. 1
Pre-amplifier, AUX 2, Phono 4, Tape 4	PC No. 6	D No. 2
Tape monitor, Tape in, Ambio, Level amplifier	PC No. 7	D No. 2
EL switch	PC No. 8	D No. 3
FM tuning potentiometers	PC No. 9	D No. 3
Tone amplifier	PC No. 10	D No. 4
Output amplifier	PC No. 11	D No. 4
Motor control	PC No. 12	D No. 4
Motor operation	PC No. 13	D No. 4
Remote control receiver	PC No. 14	D No. 3
SQ decoder	PC No. 16	D No. 2
Remote control transmitter	PC No. 17	D No. 3

ADJUSTMENT OF POWER SUPPLY SECTION

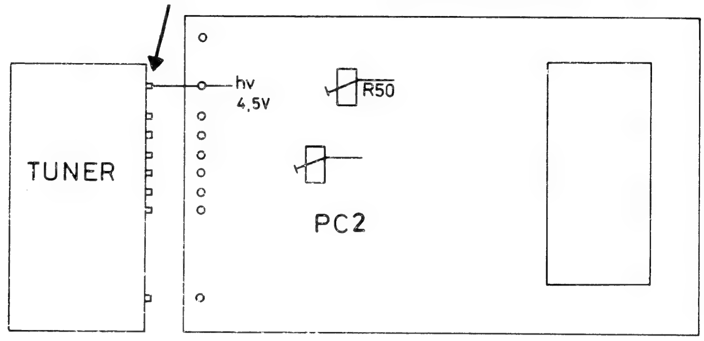


18 V adjustment: Switch receiver to FM. Using potentiometer 5R11, adjust for 18 V.

-5 V adjustment: Using potentiometer 5R5, adjust for -5 V.

Repeat 18 V adjustment.

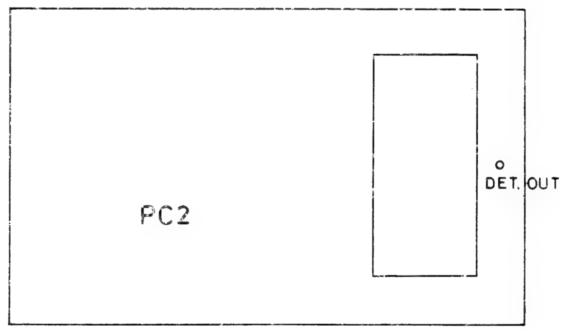
ADJUSTMENT OF BOTTOM VOLTAGE

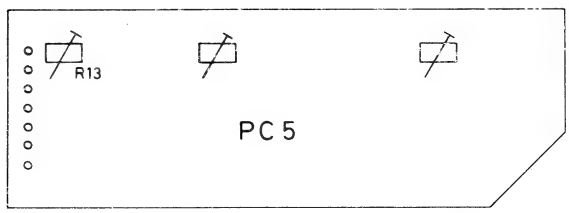


This adjustment is performed with the receiver switched to FM and the dial turned all the way down.

Using potentiometer 2R50, adjust tuning voltage to 4.5 V as measured between chassis potential and the point on the tuner indicated on the sketch.

ADJUSTMENT OF BALANCE LIGHTS 4IL2, 4IL3

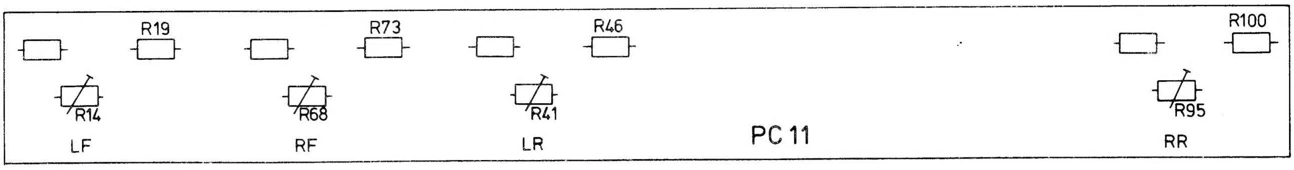




Tune in a station so that 0 V is measured at PC 2 DET. OUT.

Then depress the AFC button and adjust potentiometer 5R13 so that the balance lights have equal brightness.

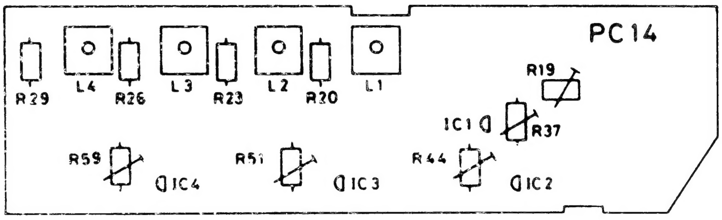
ADJUSTMENT OF NO-SIGNAL CURRENT (LF)



Switch the receiver to Stand By ON. Turn potentiometer 11R14 fully anti-clockwise and adjust no-signal current while the receiver is cold.

With 11R14, adjust for 7.2 mV across collector resistor 11R19. No-signal current can also be adjusted by measuring the collector current of 0IC4. Unsolder one end of 11R19 and insert an ammeter. Install a 1 μF capacitor across the ammeter. With 11R14, adjust for 60 mA.

ADJUSTMENT OF RECEIVER



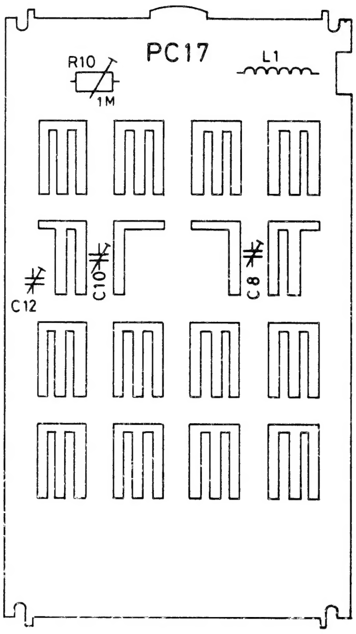
Adjustment of 14L1 - 14L2 - 14L3 - 14L4.

1. Set receiver to stand by on condition.
2. Turn off modulation on frequency standard.
3. Place frequency standard approx. 10 cm from receiver microphone.
4. Connect oscilloscope to 14R26 (coil side).
5. Set frequency standard to operate at 34.00 kHz and adjust 14L3 to phase coincidence on oscilloscope screen.
6. Connect oscilloscope to 14R20 (coil side).
7. Set frequency standard to operate at 36.86 kHz and adjust 14L1 to phase coincidence on oscilloscope screen.
8. Connect oscilloscope to 14R29 (coil side).
9. Set frequency standard to operate 39.72 kHz and adjust 14L4 to phase coincidence on oscilloscope screen.
10. Connect oscilloscope to 14R23 (coil side).
11. Set frequency standard to operate at 42.58 kHz and adjust 14L2 to phase coincidence on oscilloscope screen.

Phase coincidence means that the two marks on the sine-wave curve have the same height.

ADJUSTMENT OF COMMANDER
Current drain

1. Remove topplate.
2. Connect commander to external 12.5 power supply. Insert milliammeter in series with power supply.
3. Turn on commander and adjust 17R10 for 3.5 mA reading when the lowest frequency is activated. If adjustment is made with disconnected modulation, 7.0 mA must be measured at the lowest frequency.



Commander Frequencies

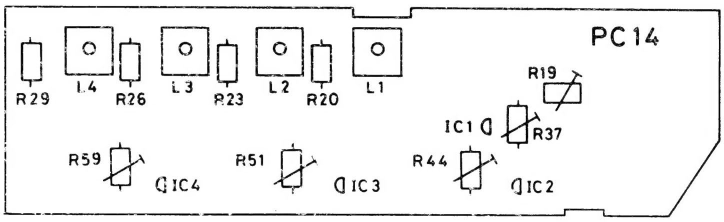
A correctly adjusted and aligned receiver is required for this adjustment.

1. Replace commander's bottom and top plates with same plates intended for adjustment, and then modulation is disconnected.
2. Connect oscilloscope to 14R26 (coil side).
3. Set commander to operate at 34.00 kHz and adjust 17L1 to phase coincidence on oscilloscope screen.
4. Connect oscilloscope to 14R20 (coil side).
5. Set commander to operate at 36.86 kHz and adjust 17C8 to phase coincidence on oscilloscope screen.
6. Connect oscilloscope to 14R29 (coil side).
7. Set commander to operate at 39.72 kHz and adjust 17C10 to phase coincidence on oscilloscope screen.
8. Connect oscilloscope to 14R23 (coil side).
9. Set commander to operate at 42.58 kHz and adjust 17C12 to phase coincidence on oscilloscope screen.

Adjustment of Amplitude

1. Turn off modulation on frequency standard.
2. Set receiver to stand-by ON and place frequency standard approx. 10 cm from receiver.
3. Connect RV9 LF voltmeter to 14R26 (coil side).
4. Set frequency standard to operate at 34.00 kHz and adjust 14R19 for 1 V voltmeter reading.
5. Connect RV9 to 14R20 (coil side).
6. Set frequency standard to operate at 36.86 kHz and check that voltage reading does not differ from 1 V by more than ± 1 dB.
7. Connect RV9 to 14R29 (coil side).
8. Set frequency standard to operate at 39.72 kHz and check that voltage reading does not differ from 1 V by more than ± 1 dB.
9. Connect RV9 to 14R23 (coil side)
10. Set frequency standard to operate at 42.58 kHz and check that voltage reading does not differ from 1 V by more than ± 1 dB.

The requirement of this adjustment is that the difference between the highest and the lowest reading must not exceed 2 dB. If the difference exceeds 2 dB, cut approx. 1 mm off the core of the coil producing the lowest reading. In that event the core must be readjusted.
1 mm represents approx. 1.5 dB.



Adjustment of LF Filters

1. Connect receiver to mains and turn on. Loudspeaker-switch Front/Rear disconnect.
2. Place frequency standard approx. 10 cm from receiver. Turn on modulation.
3. Connect RV9 LF Voltmeter to 14IC1 collector.
4. Set frequency standard to operate at 148 Hz and adjust 14R37 1 V voltmeter reading.
   Check that voltage falls to zero when frequency standard is turned off.
5. Connect RV9 LF Voltmeter to 14IC2 collector.
6. Set frequency standard to operate at 192 Hz and adjust 14R44 for 1 V voltmeter reading. Check that voltage falls to zero when frequency standard is turned off.
7. Connect RV9 LF Voltmeter to 14IC3 collector.
8. Set frequency standard to operate at 250 Hz and adjust 14R51 for 1 V voltmeter reading. Check that voltage falls to zero when frequency standard is turned off.
9. Connect RV9 LF voltmeter to 14IC4 collector.
10. Set frequency standard to operate at 330 Hz and adjust 14R59 for 1 V voltmeter reading. Check that voltage falls to zero when frequency standard is turned off.

TECHNICAL DATA		Subject to change without notice
	DIN 45 500 REQUIREMENTS	**BEOMASTER 6000, TYPE 2702**
Amplifier		
Power output at specified		
distortion, 1000 Hz RMS	2 x 6 watts	4 x 40 watts/4 ohms
		4 x 30 watts/8 ohms
Music power		4 x 75 watts/4 ohms
		4 x 40 watts/8 ohms
Speaker impedance	4 or 8 ohms	4 ohms
Harmonic distortion DIN 45 500		
1000 Hz, 50 mW output		$<$0,06 %
1000 Hz, at stated output	$\leq$ 1 %	$<$0,1 %
Intermodulation DIN 45 500	$\leq$ 3 %	$<$0,3 %
Frequency range DIN 45 500 ± 1,5 dB	40 - 16.000 Hz	20 - 30.000 Hz
Power bandwidth DIN 45 500	40 - 12.500 Hz	10 - 30.000 Hz
Damping factor DIN 45 500, 1000 Hz	$\geq$ 3	$>$20
Input, pickup low impedance	$\leq$ 5 mV/47 k ohms	2,5 mV/47 k ohms
2 channel, high impedance	$\leq$ 500 mV/470 k ohms	200 mV/470 k ohms
4 channel		200 mV/470 k ohms
Signal-to-noise ratio DIN 45 500		
50 mW, pickup low impedance	$\geq$ 50 dB	$>$60 dB
50 mW, high impedance		$>$60 dB
Channel separation DIN 45 500, 1000 Hz	$\geq$ 40 dB	$>$45 dB
250 - 10.000 Hz	$\geq$ 30 dB	$>$35 dB
Output DIN 45 500, 1000 Hz high imp.	0,1 - 2 mV per 1 k ohm	15 mV/10 k ohms
Headphones		Max. 13 V/200 ohms
Bass control at 40 Hz		± 17 dB
Treble control at 12.500 Hz		± 14 dB
Hi filter		6000 Hz 12 dB/octave
Lo filter		80 Hz 12 dB/octave
FM tuner		
Range		87,5 - 104 MHz
Sensitivity 26 dB ± 40 kHz		$<$1,4 μV/75 ohms
Sensitivity IHF		$<$2 μV/75 ohms
Limiting – 3 dB ± 40 kHz		$<$1 μV/75 ohms
Signal-to-noise ratio DIN 45 500	$\geq$ 54 dB	$>$65 dB
Selectivity IHF		$>$55 dB
Frequency range DIN 45 500 ± 1,5 dB	50 - 6.300 Hz	20 - 15.000 Hz
Harmonic distortion DIN 45 500	$\leq$ 2 %	$<$0,4 %
Stereo channel separation DIN 45 500	$\geq$ 26 dB	$>$35 dB
Pilot suppression 19 kHz	$\geq$ 20 dB	$>$45 dB
38 kHz	$\geq$ 30 dB	$>$45 dB
Other data		
Power supply		110 - 130 - 220 - 240 volts
Power consumption		10 - 350 watts
Dimensions W x H x D		67 x 8 x 32 cm
Weight		16 kg